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ORIGINAL ARTICLES.

ORIGINAL INVESTIGATIONS ON THE HEATING AND VENTILATION OF SCHOOL BUILDINGS.

Read in the Section of State Medicine, at the Forty-second Annual Meeting of the American Medical Association, at Washington, D. C., May, 1891.

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At the meeting of the American Medical Association, held at Newport, R. I., two years ago, a special committee was appointed by the Section of State Medicine on "school hygiene," consisting of Dr. D. F. Lincoln, Geneva, N. Y.; Dr. J. A. Schenck, Topeka, Kan.; Dr. Geo. H. Rohé, Baltimore, Md.; Dr. J. G. Pinkham, Lynn, Mass.; and the author.

After some correspondence, it was decided to divide the work of this committee, and as a result, I was assigned the "original investigations on the heating and ventilation of school buildings."

After no small amount of research among the multiplicity of reports of the numerous air analyses of the different school-rooms in the various cities, I found them all practically valueless, so far as making anything like a systematic comparison of results was concerned, of even an approximately scientific character.

By this I mean to say that they all lacked the details regarding those numerous modifying elements, which of necessity surround each individual room; such as the temperature *outside* of the school building; the temperature *inside* of the same at the level of the floor, mouth and ceiling, both in the front and at the rear of the room, the same observations regarding the humidity, as well as that of the carbon dioxide; the number of scholars present; the size of the room; the method of heating the same, as well as the system of ventilation employed; the amount of fresh air supplied, and the quantity of foul air discharged from a room, in a given time, together with the barometric pressure—each one of which is an important arc of a complete circle; and of necessity must all be considered together, and due credit given each one, in order to obtain anything like definite or reliable information regarding any special method or system of heating and ventilating a given room or a certain building.

With a view of obtaining the most reliable results possible, I devised a blank chart, which I thought would, as near as possible, contain all these more important factors.

I then determined to pursue the same line of investigation, of different school-rooms in the same building; and different buildings in the same city; and different cities in the same State; among which I designed to embrace as large a variety of the various methods of heating and ventilation, as we practically could, and to repeat our examinations sufficiently often on the same systems, when at all practical, to enable us to arrive at some definite conclusions, regarding any special method of heating and ventilation, if such were at all possible.

As a result, I prepared a chart which embraces the following details:

1st.—Date and time of day inspection was made.

2nd.—Name of school building.

3rd.—Name of school-room.

4th.—Number of pupils present.

5th.—Number of cubic feet of air contained in the room.

6th.—Temperature outside of the building.

7th.—Humidity outside of the building.

8th.—Barometric pressure in inches.

9th.—State or condition of the weather.

10th.—Kind of heating apparatus in use.

11th.—System of ventilation employed.

12th.—Number of cubic feet of fresh air supplied per hour.

13th.—Number of cubic feet of foul air discharged per hour.

14th.—Temperature at the front of the room. *a*, at the floor; *b*, at the mouth; *c*, at the ceiling.

15th.—Temperature at the rear of the room. *a*, at the floor; *b*, at the mouth; *c*, at the ceiling.

16th.—Humidity at the front of the room. *a*, at the floor; *b*, at the mouth; *c*, at the ceiling.

17th.—Humidity at the rear of the room. *a*, at the floor; *b*, at the mouth; *c*, at the ceiling.

18th.—The amount of carbon dioxide found in the air of the city per 10,000 parts.

19th.—The amount of carbon dioxide per 10,000 parts found in the air in the front of the room. *a*, at the floor; *b*, at the mouth; *c*, at the ceiling.

20th.—The amount of carbon dioxide per 10,000 parts found in the air at the rear of the room. *a*, at the floor; *b*, at the mouth; *c*, at the ceiling.

BACTERIOLOGICAL INVESTIGATION.

21st.—Germs found in the air of school rooms when occupied. *a*, near the floor at the point of entrance of the fresh air; *b*, near the floor at point of exit of foul air.

22nd.—Miscellaneous observations.

Having completed the general plan of investigations, I then determined to investigate, as far as practicable, the following methods of heating and ventilating school rooms.

1st.—School rooms warmed by common stoves, with and without any provisions for ventilation, other than windows, doors and transoms.

2nd.—School rooms warmed by small furnaces placed in each room, which heated fresh air received from the outside, and delivered it to the room, with and without provisions for the escape of the foul air, other than that furnished by the doors, windows and transoms.

3rd.—School rooms warmed by furnaces or heaters, and ventilated at the top.

4th.—School rooms warmed by furnaces or heaters, and ventilated at the floor.

5th.—School rooms warmed by furnaces or heaters, and ventilated at the floor and ceiling both.

6th.—School rooms warmed by direct steam and ventilated by doors, transoms and windows.

7th.—School rooms warmed by indirect steam and only ventilated by foul air ducts, windows and transoms.

8th.—School rooms warmed by both direct and indirect steam and ventilated by foul air shafts, windows and transoms.

9th.—A school room warmed by direct steam, and ventilated by an open fire place and a top ventilator.

10th.—School rooms warmed by a furnace which delivers the hot air to the room at the floor, and which room is also supplied with cold fresh air at the floor, and is provided with means for removal of foul air at the top of the room.

11th.—School rooms warmed by an air warmer, which supplies the warm air at the floor, and removes the foul air at the floor without the aid of open doors, windows or transoms.

After having completed the outline of these proposed investigations, I next found it quite a difficult task to secure the services of a competent chemist, who was willing and able to undertake the work I had laid out. But after corresponding with the chemists of several cities, I obtained the services of Prof. Lewis Schmidt, B. Sc. (Mass. Institute of Technology), of Cincinnati, Ohio, to undertake the chemical investigations, together with the humidity, temperature, etc., etc.; which he conducted throughout the entire investigation for me, in a perfectly satisfactory manner.

The original report contemplated the examinations for carbon monoxide (C O) but as this product is seldom found in the air, except when it has been passed for a considerable period, of at least two hours, over red hot iron plates, we decided to omit this part of the report, and also the examination for organic matter, owing to the impractical character of the former, and the unreliable methods of determining with any degree of scientific accuracy the latter.

Arrangements were supposed to have been made with a couple of bacteriologists to complete the bacteriological part of the work in a systematic manner. But when their work was received, it was found to have been conducted in such a *helter-skelter* manner, as to render it utterly valueless for this report, and in consequence I was compelled to omit it entirely. In fact I don't think it has detracted anything from the practical value of the report at best; my experience in this direction, has led me to conclude that there is little to be derived from this particular field, of a practical character, that will effect either the heating or ventilation of school rooms, either pro or con. Yet if properly conducted in a *systematic* manner, it might be made to serve the purpose of proving whether the germs are increased or diminished in quantity, from the time the air enters the room until it leaves it, and approximately to what extent, and under what circumstances. Outside of this I cannot concieve of any particular value to be derived from it; and certainly not when made without any apparent reference to a definite object, as was done in this case.

I next selected Cleveland, Mansfield, Columbus and Cincinnati, Ohio, for the cities in which I would conduct the proposed investigations; and to which I gave my personal attention, in Mansfield and Cleveland, and in part my personal attention in Columbus and Cincinnati, but least so in the latter, having only visited a few of the school rooms in that city, owing to unavoidable circumstances, which prevented my presence during the investigaiions there.

My instructions were to make investigations of each room, as near as possible under the conditions it was usually kept in, and to be very careful to leave nothing undone that would enable us to obtain the highest degree of accuracy possible, regardless of the system of heating and ventilation we were investigating, as we were seeking actual facts, for scientific purposes, let them reveal what they would.

In carrying out these investigations, we have

made altogether 224 determinations of the carbon dioxide, not including the examinations of the outside air; 233 determinations of the humidity, not including those made outside of the buildings; and 232 examinations of the temperature exclusive of those made outside of the buildings; saying nothing of the numerous other auxiliary observations of surrounding conditions.

These examinations were made in 39 different school rooms, of 23 different school buildings, in 4 different cities, and include 10 different systems of heating and ventilation.

By referring to the itemized charts, you will observe that we have examined the air in 10 rooms in Mansfield, 7 rooms in Cleveland, 4 rooms in Columbus, and 18 rooms in Cincinnati: which embraced 11 rooms heated by the so-called Grossius system; 11 rooms warmed by the Smead system; 5 by the Johnson system; 3 by indirect steam; 3 by common stoves; 2 by direct steam; 1 each by the Patric and Miller furnaces; direct steam with an open grate, and direct and indirect steam. You will also observe that we have made 6 examinations each, of the temperature, humidity and carbonic dioxide in each room, vis.: two each at the floor, one each in the front and rear of the room; two at the mouth, one each in the front and rear of the room; and two at the ceiling, one each at the front and rear of the room; besides all the supplementary investigations we have associated with these three primary determinations.

In making these investigations we used tested Fahr. thermometers for obtaining the temperature; whilst a carefully constructed hygrometer was used for determining the amount of moisture contained in the air, the scale of which was so constructed as to represent complete saturation at 100 and complete dryness at 0. For determining the velocity of the currents of air, we used a delicately constructed anemometer, which would register the velocity of any current of air, that was moving over 30 feet a minute. By means of glass rods, rubber hose and a small bellows, we could obtain air from any desired part of the room, a given quantity of which was pumped into clean dry bottles, of a known capacity, which were carefully corked and labeled, and taken to the laboratory for the determinations of the CO_2 which was obtained by neutralizing the carbon dioxide with a barium solution of a known quantity and strength, and calculating the amount of CO_2 per 10,000 parts of air from that, in the usual manner, which is familiar to all practical chemists.

By referring to these itemized charts, one of which has been prepared for each city, in which examinations of the air was made, you will observe that with the exception of the Smead system, either doors, windows and transoms, or all, were relied on for ventilating and regulating the temperature of the room.

From these *itemized charts* we have compiled a number of tables which embrace:

1. The highest and lowest temperature, and the highest and lowest humidity, outside of the building examined, and also the average temperature and humidity of the air of the city, which we have shown: *a*, as found in each city; *b*, as found associated with each system of heating and ventilation; *c*, the general average of each.

TABLE I.

Showing the highest and lowest temperature and the highest and lowest humidity outside of the buildings, together with the average of the same, by cities.

LOCATION.		Temperature outside of the Building, Fah.	Humidity outside of the Building, based on 100 for complete saturation.	Total number of examinations made.
Mansfield, Ohio.	Highest . .	38.0	89.8	. . . .
	Lowest . .	27.5	46.3	. . . .
	Average . .	32.0	71.1	10
Cleveland, Ohio.	Highest . .	55.2	89.5	. . . .
	Lowest . .	33.0	35.4	. . . .
	Average . .	45.3	49.0	7
Columbus, Ohio	Highest . .	53.0	59.4	. . . .
	Lowest . .	44.5	42.3	. . . .
	Average . .	49.5	50.8	4
Cincinnati, Ohio	Highest . .	69.0	100.0	. . . .
	Lowest . .	33.5	48.0	. . . .
	Average . .	52.0	75.3	18
				Total 39
Grand average for the four cities above named out of 39 examinations	Highest . .	52.0	75.3	. . . .
	Lowest . .	32.0	49.0	. . . .
	Average . .	44.9	61.5	. . . .

2. The highest and lowest temperature, and the highest and lowest humidity inside of the school rooms examined, together with the average of the same: *a*, as found in each city; *b*, as found associated with each system of heating and ventilation; *c*, the general average of each.

3. The highest and lowest amount of carbon dioxide found per 10,000 parts of air, inside of the school rooms, and the average of the same: *a*, as found in each city; *b*, as found associated with each system of heating and ventilation; *c*, the general average of each.

4. The average amount of carbon dioxide found per 10,000 parts in each city.

Before commencing the study of these tables it might be well to remark that 70° Fahr. is a fair average standard to adopt for the temperature of a school room, and from 40 to 50 for the ideal range of humidity, and whilst the CO_2 varies in different cities, and on different days in the same city, and at different times in the same day, yet we have found that the general average in the four cities under consideration, was 4.853 parts in 10,000 parts of air, which we will be obliged to use in this case for the standard of our comparisons.

We will readily observe that tables Nos. 1 and 2 are only designed to prepare us for those which are to follow, by giving us the *outside* relations of the same conditions we are about to consider *inside* of the school rooms.

TABLE II,

Showing the highest and lowest temperature and the highest and lowest humidity outside of the buildings, together with the average of the same by systems.

		Temperature outside of the Building. Fah.	Humidity outside of the Building, based on 100 for complete saturation.	Total number of examinations made.
Grossius System (with open windows, etc.)	Highest	68.1	95.2	....
	Lowest	29.5	46.3	....
	Average	43.1	80.7	11
Smead System (with no open doors, windows or transoms)	Highest	69.0	100.0	...
	Lowest	52.0	42.3	....
	Average	52.7	64.9	11
Johnston System (with open windows, etc.)	Highest	62.0	66.9	....
	Lowest	41.0	48.0	....
	Average	49.7	59.3	5
Indirect Steam (with open windows, etc.)	Highest	54.5	40.1	....
	Lowest	41.5	35.4	....
	Average	48.0	37.5	3
Common Stove (with open windows, etc)	Highest	55.2	62.4	....
	Lowest	27.5	47.9	....
	Average	37.4	53.4	3
Direct Steam (with open windows, etc.)	Highest	41.0	89.5	....
	Lowest	33.0	48.8	....
	Average	37.0	69.1	2
Patric Furnace (with open windows, etc.)	Highest	....	....	....
	Lowest	....	....	....
	Average	32.1	89.5	1
Miller Furnace (with open windows, etc.)	Highest	....	....	....
	Lowest	....	....	....
	Average	33.5	94.8	1
Direct Steam, with open fire grate (with open windows, etc.)	Highest	....	....	....
	Lowest	....	....	....
	Average	29.0	61.9	1
Direct and Indirect Steam (with open windows, etc.)	Highest	....	....	....
	Lowest	....	....	....
	Average	44.5	56.0	1
				39

By studying table No. 3, you will observe that we have given the *extremes* of temperatures and humidities, as well as the average temperatures and humidities found in the four cities, *without* regard to the system of heating and ventilation which produced them; whilst table No. 4 considers the same conditions *with* reference to the systems of heating and ventilation that produced these results; whilst table Nos. 5 and 6 show the determinations of carbon dioxide, in the same manner as described for the temperature in tables No. 3 and 4.

The limited time and space allotted to this paper will not permit me to enter into a detailed discussion of these numerous tables, which represent a multiplicity of conditions, which modify and change the general results, all of which must be duly considered, in order to arrive at legitimate conclusions.

For the present, at least, I will have to content myself with giving you an accumulation of data, which I will be obliged to leave for you to study at your leisure; whilst I proceed to consider some of the more prominent features of this report.

THE HEATING.

By examining this report you will observe, that we have examined quite a variety of methods of heating, which has shown a still greater range of temperature, which is especially noticeable between the floor and top of the room; but when you come to compare the *general average* of the temperatures taken of the different systems, they vary but little at the same point of the different levels, which at the floor, in the front of the rooms show a range of from 59.5° to 68.8°, and at the mouth in front from 67.0° to 73.8°, and at the ceiling in front from 68.5° to 85.0°, whilst there is quite a difference in the range of the average of the ceiling temperatures, there is a much greater difference observed between the floor and ceiling, which ranges from 59.5° to 85.0°, or a difference of 25.5°.

Again, in the average at the rear of the room, the range of temperatures at the floor varies from 60.0° to 74.5°, and at the mouth from 64.0° to 70.2°; and at the ceiling from 70.7° to 90.0°; whilst at the rear of the rooms there was found to be a difference between the lowest average at the floor, and the highest average at the ceiling of 30.0°.

It must be remembered in the study of these results, that with the single exception of the Smead system, the temperature in every instance was modified by open doors, windows or transoms, and not unfrequently all of them. In the majority of instances the windows were open several inches between the sash and very frequently at the top, and often at the bottom; and which not unfrequently had a strong ally in the form of an open transom or door. These methods of modifying the temperature, to a certain extent accomplished the desired results, so far as the average temperature was concerned, but at a great expense of fuel and waste of heat; and unavoidable exposure of the pupils to cold and changeable drafts of air.

On the other hand, the Smead system of heating accomplished even better average results, and very much better individual results, at the different levels of the room, than any other system examined, and that, too, without exposing the pupils to cold changeable drafts of air from open doors, windows and transoms; saying nothing of the economy of fuel by the prevention of the unnecessary waste of heat through these objectionable openings in the doors, windows and transoms.

THE HUMIDITY.

The amount of moisture contained in the air

TABLE III,

Showing the highest and lowest temperature and the highest and lowest humidity inside the school-rooms, together with the average of the same, by cities.

LOCATION.		Temperature Front of Room.			Temperature Rear of Room.			Humidity Front of Room.			Humidity Rear of Room.			Total Number of Examinations Made.
		At the Floor	At the Mouth	At the Ceiling	At the Floor	At the Mouth	At the Ceiling	At the Floor	At the Mouth	At the Ceiling	At the Floor	At the Mouth	At the Ceiling	
Mansfield, Ohio . . .	Highest . .	70.0	73.8	92.5	68.5	72.5	90.0	56.6	49.0	46.8	53.9	52.5	43.7	. . . .
	Lowest . .	57.5	63.5	69.0	54.0	61.5	70.0	36.1	29.5	12.9	34.0	30.2	16.5	. . . .
	Average . .	62.5	67.7	79.7	61.9	66.5	80.6	43.3	40.0	25.1	45.1	42.4	25.5	10
Cleveland, Ohio . . .	Highest. . .	73.0	77.0	81.9	70.5	75.5	85.5	39.8	39.3	31.4	45.4	45.1	31.4	. . . .
	Lowest . .	66.5	67.0	74.0	65.0	67.0	75.0	24.0	28.7	16.6	32.0	28.3	20.4	. . . .
	Average . .	69.5	71.9	77.2	67.8	70.9	78.2	33.5	33.6	23.9	37.2	34.8	24.3	7
Columbus, Ohio . .	Highest . .	67.0	69.5	77.0	68.3	69.0	79.0	53.9	45.7	43.7	48.7	43.2	42.0	. . . .
	Lowest . .	63.5	67.4	56.2	60.0	64.0	56.1	45.0	42.4	29.9	38.1	38.5	31.2	. . . .
	Average . .	65.1	68.2	69.1	65.2	66.6	69.5	49.3	43.6	36.0	42.0	41.1	36.1	4
Cincinnati, Ohio . .	Highest. .	73.5	73.5	74.5	74.5	74.0	75.5	97.3	97.3	97.5	97.1	97.9	91.6	. . . .
	Lowest . .	63.0	63.1	68.0	62.5	63.0	63.5	28.5	26.8	22.9	25.6	33.0	23.5	. . . .
	Average . .	68.3	68.6	71.2	68.8	68.8	71.1	55.0	53.2	43.4	51.1	53.5	47.3	18
														Total 39
Grand average for the 4 cities above named out of 39 examinations . . .	Highest. . .	69.5	71.9	79.7	68.8	70.9	80.6	55.0	53.2	43.4	51.1	53.5	47.3	. . . .
	Lowest . .	62.5	67.7	69.1	61.9	66.5	69.5	33.5	33.6	23.9	37.2	34.8	24.3	. . . .
	Average . .	66.2	69.1	74.3	65.9	68.2	74.8	45.2	42.6	32.1	43.8	42.9	33.3	. . . .

Total number of temperatures taken in the 4 cities, 232. Total number of humidities taken in the 4 cities, 233.

TABLE IV,

Showing the highest and lowest temperature and the highest and lowest humidity inside the school-rooms, together with the average of the same.

		Temperature Front of Room.			Temperature Rear of Room.			Humidity Front of Room.			Humidity Rear of Room.			Total Number of Examinations Made.
		At the Floor	At the Mouth	At the Ceiling	At the Floor	At the Mouth	At the Ceiling	At the Floor	At the Mouth	At the Ceiling	At the Floor	At the Mouth	At the Ceiling	
Grossius System (with open windows, etc.). .	Highest .	72.3	73.5	85.0	73.5	74.0	90.0	67.8	61.8	66.5	66.5	59.6	55.2	. . .
	Lowest . . .	63.0	63.1	68.0	60.5	64.0	67.0	36.1	38.2	17.5	42.2	39.5	17.5	. . .
	Average .	66.6	67.3	74.3	66.4	68.1	74.9	48.5	46.7	38.2	50.5	47.1	37.0	11
Smead System (with no open doors, windows or transoms)	Highest. .	73.5	76.0	81.9	74.5	75.5	81.0	97.3	97.3	97.5	97.1	97.9	91.6	. . .
	Lowest . . .	64.0	66.5	56.2	62.5	63.0	56.1	28.5	26.8	22.0	29.2	28.3	16.6	. . .
	Average .	68.2	70.0	71.8	68.0	68.6	70.7	52.6	50.4	44.7	50.8	51.5	44.4	11
Johnston System (with open windows, etc.). .	Highest. .	71.8	72.0	74.5	72.0	72.1	73.5	57.9	63.5	55.1	55.3	59.0	54.8	. . .
	Lowest . . .	64.5	67.5	69.1	66.0	68.0	69.2	36.0	40.5	33.0	40.1	37.5	34.4	. . .
	Average .	68.5	69.1	72.2	68.8	69.6	71.5	49.0	50.7	42.7	48.7	49.6	45.0	5
Indirect Steam (with open windows, etc.). .	Highest. .	71.0	72.0	76.0	70.0	71.5	76.5	31.6	33.0	23.2	38.1	33.6	24.4	. . .
	Lowest . . .	66.5	67.0	74.0	65.0	67.0	75.0	24.0	26.5	16.6	32.0	32.9	20.4	. . .
	Average .	68.8	70.0	75.1	67.6	69.8	75.8	27.5	29.4	19.8	35.0	33.3	21.9	3
Common Stove (with open windows, etc.). .	Highest. .	73.0	77.0	92.5	68.0	71.0	84.0	55.6	42.7	32.8	49.3	48.1	33.7	. . .
	Lowest . . .	57.5	63.5	69.0	54.0	61.5	70.0	38.7	36.7	18.8	45.8	45.1	25.8	. . .
	Average .	62.8	70.2	80.3	60.3	66.2	77.0	46.2	39.7	26.2	46.5	46.6	30.3	3
Direct Steam (with open windows, etc.)	Highest. .	67.5	71.5	77.0	67.2	70.5	85.5	39.8	39.3	31.4	45.4	35.9	28.1	. . .
	Lowest . . .	67.0	69.0	76.5	66.5	70.0	77.0	39.2	39.1	27.6	32.9	34.4	24.1	. . .
	Average .	67.2	70.2	76.7	66.8	70.2	81.2	39.5	39.2	29.5	39.1	35.1	26.1	2
Patric Furnace (with open windows, etc.). .	Highest. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	Lowest . . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	Average .	60.0	64.0	78.0	62.0	65.5	90.0	41.7	40.5	20.9	42.2	42.3	16.5	1
Miller Furnace (with open windows, etc.). .	Highest. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	Lowest . . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	Average .	65.0	67.0	68.5	74.5	69.2	74.5	61.2	41.5	49.2	25.6	38.8	24.8	1
Direct steam with open fire grate (with open windows, etc.)	Highest. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	Lowest . . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	Average .	59.5	73.8	85.0	58.0	68.2	88.0	41.2	33.0	20.1	42.1	36.5	18.9	1
Direct and Indirect Steam (with open windows, etc.)	Highest. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	Lowest . . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	Average .	63.5	69.5	77.0	60.0	64.0	79.0	53.9	45.7	31.4	39.2	38.5	31.7	1
														39

Total number of temperatures taken on all the systems, 232. Total number of humidities taken on all the systems, 233.

of our school rooms should not be lost sight of. Warm air that is *too* dry, is irritating to the respiratory tract, and is more liable to be charged with dust, than air containing a greater amount of moisture; whilst air that is *over*charged with moisture at the same temperature creates a sul-

TABLE V,

Showing the highest and lowest amount of Carbon Dioxide per 10,000 parts inside the school-room, and the average of the same, together with the amount of CO_2 per 10,000 parts in the city air, by cities.

LOCATION.		Amount of Carbon Dioxide found in the air of the city per 10,000 parts.	Amount of Carbon Dioxide per 10,000 parts front of Room.			Amount of Carbon Dioxide per 10,000 parts rear of Room.			Total Number of Examinations
			At the Level of the Floor.	At the Level of the Mouth.	At the Level of the Ceiling.	At the Level of the Floor.	At the Level of the Mouth.	At the Level of the Ceiling.	
Mansfield, Ohio	Highest		21.495	21.742	24.727	28.281	21.875	25.690	
	Lowest		11.104	9.855	9.914	11.318	10.016	11.473	
	Average	4.728	15.478	15.310	15.923	17.391	16.290	16.642	
Cleveland, Ohio	Highest		17.560	16.997	17.505	17.792	17.160	16.275	
	Lowest		6.694	7.065	10.001	8.181	10.268	19.363	
	Average	5.006	12.506	12.424	12.335	13.434	13.349	13.897	
Columbus, Ohio	Highest		14.220	15.772	15.102	18.697	15.659	14.300	
	Lowest		10.705	11.253	9.239	10.252	10.285	9.751	
	Average	4.291	12.826	14.531	11.228	14.219	13.098	12.667	
Cincinnati, Ohio	Highest		14.765	16.991	16.610	19.388	16.765	19.228	
	Lowest		8.324	10.158	7.196	7.142	7.261	7.430	
	Average	5.590	11.740	12.878	12.770	12.357	11.869	12.442	
Grand Average for the four cities above named out of 39 examinations	Highest		15.478	15.310	15.923	17.391	16.290	16.642	
	Lowest		11.740	12.424	11.228	12.357	11.869	12.442	
	Average	4.853	13.137	13.785	13.064	14.350	13.651	13.912	

Total number of CO_2 determinations taken in the four cities, 224.

TABLE VI,

Showing the highest and lowest amount of Carbon Dioxide per 10,000 parts inside the school-room, and the average of the same, by Systems.

		Amount of Carbon Dioxide per 10,000 parts front of Room.			Amount of Carbon Dioxide per 10,000 parts rear of Room.			Total Number of Examinations
		At the Level of the Floor.	At the Level of the Mouth.	At the Level of the Ceiling.	At the Level of the Floor.	At the Level of the Mouth.	At the Level of the Ceiling.	
Grossius System (with open windows, etc.)	Highest	21.495	21.742	24.727	28.281	21.875	25.690	
	Lowest	6.741	10.768	7.196	7.142	7.261	7.430	
	Average	12.951	15.294	14.773	14.500	14.093	14.068	
Smead System (with no open doors, windows or transoms)	Highest	15.700	15.772	16.610	19.388	16.765	19.228	
	Lowest	10.760	11.255	9.239	11.750	10.016	10.824	
	Average	13.437	14.216	13.219	14.685	13.682	14.605	
Johnston System (with open windows, etc.)	Highest	14.130	16.991	16.150	15.741	12.511	15.780	
	Lowest	9.669	10.158	9.896	8.757	9.178	10.025	
	Average	10.352	12.866	12.574	11.897	10.841	11.972	
Indirect Steam (with open windows, etc.)	Highest	11.872	11.850	11.181	12.881	14.731	16.275	
	Lowest	6.694	7.065	10.001	8.181	10.268	9.363	
	Average	8.754	9.557	10.647	10.240	12.473	12.096	
Common Stove (with open windows, etc.)	Highest	13.872	12.378	13.926	16.098	15.391	15.733	
	Lowest	11.104	9.855	10.416	11.318	11.001	11.473	
	Average	12.683	10.802	11.911	14.442	13.173	13.534	
Direct Steam (with open windows, etc.)	Highest	17.560	16.997	17.505	17.792	17.160	15.277	
	Lowest	14.401	16.753	14.085	15.550	14.156	14.682	
	Average	15.910	16.875	15.795	16.671	15.658	14.979	
Patric Furnace (with open windows, etc.)	Highest							
	Lowest							
	Average	19.127	17.499	16.493	16.418	16.971	18.223	
Miller Furnace (with open windows, etc.)	Highest							
	Lowest							
	Average	14.392	Lost	13.682	13.286	Lost	14.221	
Direct Steam, with open grate (with open windows, etc.)	Highest							
	Lowest							
	Average	12.425	11.847	9.914	11.751	14.401	14.132	
Direct and Indirect Steam (with open windows, etc.)	Highest							
	Lowest							
	Average	10.705	11.253	10.222	10.252	10.285	9.751	

Total number CO_2 determinations taken on all the systems, 224.

try, oppressive atmosphere, which will predispose the pupils to "catching cold" on leaving the school room.

By examining these charts and tables you wil observe, that as a rule, the humidity *decreases* i the production of artificial heat, as the tempera

26	March 25, 1891, 2 to 3 p.m.	Fifth Avenue . . .	No. 3 . .	65	10,075	53.0	45.3	29.58	Bright sunshine .	Smead System	Smead system.	Could not determine.	Could not determine.	67.0	68.0	69.5	68.3	69.0	70.1	45.9
27	March 26, 1891, 10 to 11 a.m.	Garfield Avenue. .	No. 11 . .	59	11,492	44.5	56.5	29.34	Clear, turning to cloudy.	Direct and indirect steam. . .	Foul air vents, windows, doors and transoms.	" "	" "	63.5	69.5	77.0	60.0	64.0	79.0	53.9
28	Mar. 25, 1891, 10.30 to 11.30 a.m.	High School. . . .	No. 8 . .	24	11,492	47.5	59.4	29.63	Bright, sunny day.	Smead system.	Smead system.	" "	" "	64.0	68.0	56.2	65.2	66.5	56.1	52.7
29	Mar. 25, 1891, 3.15 to 4 p.m.	Eighth Avenue . .	D Prim'y	66	11 200	53.0	42.3	29.54	Bright, clear . . .	Smead system.	Smead system.	" "	" "	66.0	67.4	74.0	67.5	67.3	72.8	45.0

SCHOOL ROOMS IN MANSFIELD, O.

30	March 3, 1891, 2 to 3 p.m.	High School Bl'dg. . . .	Note 1. . .	71	25,541	37.0	80.7	28.56	Wet, cloudy, turning into snow.	See note 2.	See note 5.	Could not determine.	Could not determine.	69.5	72.0	76.0	65.5	67.0	74.5	41.6
31	March 3, 1891, 3 to 4 p.m.	High School Bl'dg. . . .	. . . .	74	25,447½	38.0	84.2	28.582	Wet, cloudy, and snowing.	Grossius system. Used two Stoves.	See note 6.	Could not determine.	Could not determine.	70.0	71.0	74.0	68.5	69.8	74.5	48.8
32	March 6, 1891, 3 to 4 p.m.	Marion Ave. Bl'dg. . . .	. . . .	57	12,852	33.0	89.8	28.62	Snowing	Grossius system ; one heater.	Windows, ventilators at floor, transoms and doors.	200 lin. feet one mom't, the next nothing.	80 lin. ft. one moment, the next nothing	63.0	65.0	85.0	67.0	72.5	90.0	47.0
33	March 4, 1891, 3 to 4 p.m.	Third Ward Bl'dg. . . .	. . . .	54	12,150	29.5	66.1	28.9	Bright and clear, snow on ground.	Grossius system, one heater.	See note 7.	Could not approx'ate	Could not determine.	60.0	65.0	75.0	60.5	64.0	75.5	41.7
34	March 5, 1891, 3 to 4 p.m.	Third Ward Bld'g. . . .	. . . .	41	13,050	33.0	46.3	29.20	Bright, sunny day.	Grossius system, one heater.	See note 8.	Could not determine.	Could not determine.	64.0	66.0	84.5	61.0	65.0	83.0	36.1
35	March 6, 1891, 10.45 to 12 m.	Fourth Ward Building.	. . . .	44	15,232	32.1	89.5	28.74	Damp and cloudy.	See note 3.	See note 9.	30 cub. feet per min.	80 cubic feet per minute.	60.0	64.0	78.0	62.0	65.5	90.0	41.7
36	March 5, 1891, 10.45 to 11.55 a.m.	Children's Home . . .	. . . .	40	6,300	29.0	61.9	29.13	Clear, sunny day, snow on ground.	Steam, with open fire grate .	See note 10	Could not determine.	Impossible to calculate.	59.5	73.8	85.0	58.0	68.2	88.0	41.2
37	March 6, 1891, 9.30 to 10.30 a.m.	Catholic Building. . . .	. . . .	59	9,100	32.0	80.2	28.81	Cloudy	Smead System	Smead system, with six foul air ventilators at the floor.	51,400	32,400	64.0	69.5	78.3	64.0	66.5	77.0	36.2
38	March 4, 1891, 10 to 11.30 a.m.	Pleasant Hill School Building.	. . . .	19	7,540	29.5	62.4	28.83	Clear, ground covered with snow.	See note 4.	None, except windows and doors.	Unknown.	Could not determine.	57.5	. . . .	92.5	59.0	. . . .	84.0	44.3
39	March 5, 1891, 10 to 10.45 a.m.	Maple Grove . . .	. . . .	18	11,799	27.5	50.0	29.12	Clear and bright, snow on ground.	One common ordinary stove.	Two registers 12x18 in., open in the ceiling.	Unknown.	Unknown . .	58.0	63.5	69.0	54.0	61.5	70.0	55.6

For names of School Room see Note 1.

Note 1.—30. Senior High School. 31. Junior High School. 32. A and B Secondary. 33. A and B. Secondary. 34. C and D Grammar No. 7. 35. C and D Grammar. 36. Children's Home. 37. II Division. 38. A single room country
Note 2.—Grossius system, which consists in a large stove, or heater, located in the room, which is so arranged as to bring a small supply of fresh air from the outside, and heat it as it passes through the stove, from which it is dis
Note 3.—Patric furnace, Comet No. 0, which receives air from the outside and warms it and delivers it to the room the same as the Grossius system. Note 4.—A so-called Baxter sanitary stove, which took the air i
Note 5.—There is no regular system employed. There are foul air vents, windows, transoms and doors used for the admission of fresh and the discharge of foul air. Note 6.—No ventilation other than that supplied by placing b
Note 7.—Three ventilators 12x14 near the top of the room, one on the west and one on the east, one on the south ; windows with 4-inch boards under them, allowing air to pass in and out between the upper and lower sash.
Note 9.—One 12x14 inch foul air ventilator situated in the side wall near the floor back of the heater, and connecting with the smoke flue. Foul air ventilators about 14x4 inches were located around the room at the floor, which dis
Note 10.—Grate fire and one register 12x14 in., one foot from ceiling, connecting with foul air duct in chimney. Windows with 4 inch boards under them, as already described. Door and transom.

MISCELLANEOUS OBSERVATIONS.

1.—Hot air ventilator supplying fresh air 16x24 inches, six foul air ventilators at the floor 32x6 inches, connecting with ventilating shaft. Average age of pupils, 7 years. Windows and doors closed.

2.—One fresh air ventilator 16x24 inches. Six foul air ventilators 32x6 inches at floor. All windows and doors closed. Average age of pupils, 7 years.

3.—One hot air vent 16x24 inches. Nine foul air ventilators 32x6 at floor. Average age of pupils, 6 years. Doors and windows all closed.

4.—Fresh air register 16x24 inches, admitting a mild current of fresh air. Nine foul air ventilators around the room at the floor, 32x6 inches. Age of pupils, 6 to 9 years.

5.—A 16x24 inch warm air ventilator furnished the fresh air, while 9, 32x6 foul air ventilators removed the foul air near the floor at the sides of the room. Age of pupils, 7 to 8 years.

6.—Fresh air ventilator 16x24 inches furnishing fresh air, nine foul air ventilators 32x6 inches, located at floor around the sides of room discharging foul air. Average age of pupils, 9 years.

In all the rooms heated by the Smead system all the doors and windows were closed, unless otherwise mentioned.

7.—This building is ventilated by means of windows and some sort of a ventilating box, transoms and doors. The ventilating box extends from the floor to the ceiling, and is about 18x2 inches, and is so arranged as to have an opening 14x22 inches at the bottom, which is fitted with a slide which can be open or shut. There is also a grated opening at the top about the same size opening into the room, but the chemist has failed to tell us whether this ventilating box is intended to admit fresh air or discharge foul air. At all events, the teacher is required to open wide all the windows every half hour for a few moments, and exercise the children, which of course, to a large extent, changes the air, whilst the transom at the top of the door is always left open, and two windows from the top about two inches. Age of pupils, 6 to 7 years.

8.—The room faces north and two windows on that side which were open about one inch from top, and one other window open about three inches from top, the location of which the chemist failed to describe. Age of pupils, 8 years. With this exception the arrangements for the ventilation of the room were practically the same as above.

9.—The windows in this room were open from top and bottom about three inches. One window at bottom registered 285 linear feet a minute. Average age of pupils, 10 years.

10.—This room was heated and ventilated on the same plan as already described for this building, two windows open at top and bottom, one door with transom above, which was open. Average age of pupils, 7 years.

11.—The door and transom in the room were wide open, also the window facing south was open six inches from top, and another window facing south open four inches from bottom. Very light fire in heater. Room faces south upon an alley. The foul air is exhausted through a shaft at this time at a rate of 60,000 cubic feet an hour. Age of the pupils, 9 to 11 years.

12.—Window facing east was open two feet from bottom, one facing north one and one-half feet from top. Through the east window, which was open at bottom, the wind entered at the rate of 600 linear feet a minute, whilst the window on the north, which was open at top, registered an outflow of 360 linear feet a minute. The wind interfered so with the foul air box that the in- and outflow could not be registered with any degree of accuracy. Age of pupils ranged from 6 to 8 years.

13.—This building was formerly heated by steam, but is now heated by furnaces. The furnaces, eight in number, are situated in the basement of the building, each one of which supplies three or four rooms with warm air. Each room is furnished with a thermometer connected by means of electric wires to the dampers of the furnace and are so constructed as to be set to any desired temperature, which in this building was 72° F., and are so arranged that when the temperature exceeds that which they are set for, the dampers are closed by means of the electric wires, or when it falls below that point the dampers are opened in a similar manner. On the floor of each room there are two fresh air shafts that connect with the outside air, which is brought in without heating. In the wall near the ceiling is another ventilating shaft to carry off the bad air in the room; but as these vents are always out of order they have to depend upon window ventilation, which they open every forty-five minutes in order to purify the air. The opening at the top of the room is connected with a central air shaft, and was designed to carry off the foul air; but being a failure, these registers are kept closed, and windows depended on instead, of which there were four on the east open three inches at the top, and one opening into hall. Age not given accurately, but said to range from 6 to 9 years.

14.—Four windows in room ; two cold air conductors in floor ; one hot air shaft in corner of room. Windows face west and north. One window opens into hall ; two doors, one leading into hall and one into closet. Transom above door in hall ; doors and transom closed. Three windows open at top. Two foul air shafts, 12x12 inches, hot air shaft 24x18 inches. In other respects the room was a duplicate of the above regarding the ventilation. Age of pupils not given accurately, but said to range from 6 to 9 years.

15.—Four windows in room face west ; one open at top, with draft of air entering room ; two doors and transom closed ; very feeble current coming in through the hot air register. Age of pupils not given accurately, but said to range from 6 to 9 years.

16.—This room contained one large register in floor, 20x32 inches, for the admission of fresh air. Two windows in back of room open five inches from top ; one window open at side of room, with current of air entering room ; two windows east, two windows north. Teachers complain of tired feeling, probably due to the presence of nitrogenous compounds resulting from the unsanitary condition of the pupils. No ages given accurately, but range from 6 to 9 years.

17.—Two conduits opening through grates in the floor for the admission of fresh air from the outside. One ventilator near ceiling for foul air. Windows face east, two open one foot from top ; four windows, three doors and three transoms in the room. With these exceptions, the heating and ventilation was the same as already described regarding this system. Chemist did not give age of pupils accurately, but range from 6 to 9 years.

18.—This room was heated by an ordinary Miller furnace located in the cellar. Fresh air from outside of building was heated and delivered to rooms above. Two hot air registers in the floor, two foul air registers in back of room near floor. Room had seven large windows, all closed except one, which was open two inches from top. Age of pupils range from 13 to 20 years.

19.—The examination was made immediately after a recess of two hours. Foul air shafts opened at the floor and connected with the attic, and from thence with cupola on top of building. Fresh air was supplied through open windows. In addition to the foul air vents at floor, there were two top ventilators. Four windows on south, two doors east, two doors west, one hall and window north, one ventilator south near floor, and one north near floor. Average age of pupils about 14 years.

20.—There were three windows north, three west, two doors east with transoms, one door and transom slightly ajar, three windows down from top on west, one foul air ventilator in floor on south, one north, and one west, 12x12 inches ; three steam radiators, one in the northwest, one in the southwest, and one southeast. Age of pupils about 10 to 12 years.

21.—This building was formerly heated and ventilated by the fan system, but owing to the noise and other imperfections, it was abandoned, and indirect steam employed, consisting of four steam radiators—two of which were shut off—over which the fresh air from the outside passed and was heated before entering the room. Four windows south, two east, lowered about six inches from top, two windows open in east about four inches from bottom, two windows on south open four inches from bottom. Two doors north with transoms. Age of pupils, 15 to 18 years.

22.—Four steam radiators in room, three south and one east, over which fresh air passed on its way into the room. There were also two cold air registers in the floor of the room, for the admission of fresh air. Cold air was passing over two of the steam radiators from the outside, three windows south open two inches from top and three inches below, two windows east both open two inches from top, and one open three inches from bottom. Age of pupils about 12 years.

23.—This room was heated by three steam radiators over which the cold air passed on its way into the room. There were six foul air vents placed in the floor, 12x18 inches, which connected with a central air shaft, of which there are four in the building. These foul air shafts are heated in winter by a furnace, and in summer by a small fire built at bottom of shaft. Four windows face south, three east, two doors north with transoms closed. All windows in south were open two inches from top, while all the windows had four-inch boards under them at bottom to allow the air to pass in and out between the upper and lower sash. Age of pupils, unfortunately, was not obtained.

24.—At the request of the principal the air in this room was investigated, as it contained the largest number of scholars, and was supposed to be the worst room in the building. There was one register 26x22 inches for the admittance of fresh air, and six outlets for foul air placed around t
dows, that communicated wi
dows north, all closed, two wi
on the east, all closed ; fire i
was qu te warm. Average age
25.—This room was venti
sash, allowing air to pass in
windows in west, one open
south, closed ; two windows
A Crown stove No. 8, made in
corner of room. Age of pupil
26.—Hot air ventilator 30x
hot air shut off, located on ea
at floor on north side the san
door and transom ; two open
one window facing north, all
8 years.
27.—This room was heated
west, with heat turned on, o
one on south with heat turn
the north, 14x14, coming thro
heating box in the cellar. On
the floor on the north, 14x14
shaft leading to the cupola ; t
open from the top ; two doors
windows are open foul air
kept shut off of indirect radia
heat the building when the fr
fresh air had to be obtained t
28.—While in this room
times. Five foul air vents on
closed with sheet iron; three
closed with sheet iron; two fo
dows west, all closed, two do
vent, about 26x22, on the nort
open or closed. Average age
29.—Hot air coming thr
windows east, three windows
north, one foul air vent in clo
et on the west, three foul air
transom closed on the south.
of the pupils in this school.
30.—On north side no foul
ventilator. On west side t
On south side the same. The
north side, with one transom
door on east side, with transo
windows open on west side
three open in the same manne
were so arranged as to allow t
the two sash. The age of pu
31.—There was no provisi
transoms and a hole 2x2 ft.
closed. There was two windows on the

ture *increases* modified by phere. For when the hu at the point same time th but little art erated, the h ingly high i sult of a con with the sar sociated wit erable quan school room school room much lower and at the will be almo You will average hur school room 27.5 to 61.2 29.4 to 50. At t 49.2. floor from 2 ranges from from 16.5 to By these the general though few Yet, notwi ine the item results in is variations o the same ro lar system has been ad On the ot circulating markable h the amount different p different ro

Notwiths ent time, w large quan school-roo their theori evidence to We mus large quant any physic observed b It is true produce fa and no do mense qua rooms; bu a large ma

Cincinnati, O., made for the Section of State Medicine of the American Medical Association for the Meeting held in

SCHOOL ROOMS IN CINCINNATI, O.

Number	Date and time of day Inspection was made.	Name of School Building.	Name of School Room.	No. of Pupils Present.	No. of cubic feet of air contained in Room.	Temperature outside of Building.	Humidity outside of Building.	Barometric Pressure in Inches.	State or Condition of the Weather.	Kind of Heating Apparatus in use.	System of Ventilation Employed.	No. cubic ft. of fresh air supplied per hour.	No. of cubic ft. of foul air discharged per hour.	Temperature Front of Room. At the Floor.	At the Mouth.	At the Ceiling	Temperature Rear of Room. At the Floor.	At the Mouth.	At the Ceiling	Hu At th Floo
1	Feb. 10, 1891, 3 P.M.	New building cor Canal and Elm	No. 10.	58	9,780	41.0	56.7	29.78	Bright and cold.	Smead system	Smead system	57,420	Could not determine.	70.2	71.5	72.0	69.8	69.6	71.3	28.5
2	Feb. 11, 1891, 2:30 p.m.	New building cor Canal and Elm	No. 16.	48	9,780	49.5	54.8	29.71	Bright and cold.	Smead system	Smead system	44,040	Could not determine.	64.0	69.2	69.0	65.5	65.6	68.5	38.5
3	Feb. 12, 1891, 2:15 p.m.	New building cor. Canal and Elm	No. 13.	48	12,333	68.0	73.1	29.17	Cloudy, dark day	Smead system	Smead system	4,740	Did not determine.	73.5	73.5	74.5	74.5	73.2	75.0	63.2
4	Feb. 13, 1891, 2:20 p.m.	New building cor. Canal and Elm	No. 18.	54	12,109	69.0	72.8	29.21	Cloudy, dark day	Smead system	Smead system	4,740	Not determined.	71.5	72.0	73.5	73.0	72.8	74.2	69.8
5	Feb. 16, 1891, 10:45 a.m	New building cor. Canal and Elm	No. 6	45	11,954	61.5	85.5	29.39	Raining.	Smead system	Smead system	6,360	Did not determine.	69.0	66.5	70.0	67.5	66.3	69.2	67.4
6	Feb. 16, 1891, 11:25 a.m	New building cor. Canal and Elm	No. 1	49	11,902	61.5	100.0	29.38	Raining.	Smead system	Smead system	14,340	Did not determine.	68.5	68.5	71.0	62.5	63.0	63.5	97.3
7	Feb. 18, 1891, 2 p.m.	Cor. Elm and Adams sts	No. 9	46	8,898	37.0	89.2	29.82	Wet and sultry, turning into snow	Grossius heater in the room, ordinary furnace for halls.	Foul air vents, windows and doors.	Could not determine.	Could not determine.	69.5	65.2	68.0	67.5	65.1	67.0	67.8
8	Feb. 18, 1891, 2:45 p.m.	Cor. Elm and Adams sts	No. 16.	48	9,016	43.0	87.9	29.81	Wet, sultry day.	Grossius system same as above.	Foul air vents, windows, doors and transoms	Could not determine.	Could not determine.	63.0	63.1	68.5	63.5	66.3	69.0	37.5
9	Feb. 19, 1891, 2 p. m.	Cor. Elm and Adams sts	No. 15.	51	9,016	44.0	95.2	29.73	Wet day.	Grossius system same as above.	Same as above	No approx. est. made	No approx. estim. made.	65.5	66.0	69.0	67.1	67.0	68.5	49.1
10	Feb. 19, 1891, 2:30 p.m.	Cor. Elm and Adams sts	No. 14.	35	8,428	44.0	95.2	29.73	Raining.	Grossius system same as above.	Same as above	No estim. given.	No estimate given.	64.3	66.3	74.0	66.2	67.5	73.5	48.2
11	Feb. 20, 1891, 2 p.m.	Cor. Elm and Adams sts	No. 3	62	8,820	68.1	78.3	29.28	Windy and wet.	Same as above	Same as above	No estim. given.	60,000	72.3	73.5	71.5	73.5	74.0	75.5	62.5
12	Feb. 20, 1891, 2:35 p.m.	Cor. Elm and Adams sts	No. 2	49	8,232	67.9	75.1	29.28	Cloudy, wet and windy.	Same as above	Same as above	Could not accur. deter	Could not accur. deter.	72.0	71.0	72.5	70.1	71.0	72.9	53.9
13	Feb. 24, 1891, 1:45 p.m.	Findlay st. bldg., 20th Dist	No. 17.	47	9,360	62 0	66.5	29.26	Cloudy	See foot note 1	Foul air shafts, windows and doors.	Could not determine.	Could not determine.	71.5	72.0	74.5	72.0	72.1	73.5	57.9
14	Feb. 24, 1891, 2:30 p.m.	Findlay st. bldg., 20th Dist	No. 20.	38	10,920	61.5	66.9	29.25	Cloudy	Same as above	Same as above	Same as above.	Same	71.8	70.0	73.0	71.0	70.0	72.5	54.5
15	Feb. 25, 1891, 1:45 p.m.	Findlay st. bldg., 20th Dist	No. 10.	48	9,744	42.0	57.7	29.28	Bright and sunny day.	Same as above	Same as above	Same.	Same.	68.0	67.5	69.1	67.2	68.0	69.2	36.0
16	Feb. 25, 1891, 2:45 p.m.	Findlay st. bldg., 20th Dist	No. 13.	37	10,980	42.0	57.7	29.22	Clear and sunny	Same as above	Same as above	Could not measure on account of variable currents		64.5	68.0	73.5	66.0	68.5	72.0	55.3
17	Feb. 26, 1891, 1:45 p.m.	Findlay st. bldg., 20th Dist	No. 3	33	10,214	41.0	48.8	29.48	Bright day	Same as above	Same as above	Same as above.		67.0	68.3	71.0	68.2	69.4	70.5	41.5
18	Feb. 27, 1891, 1 to 2 p.m	White & Sykes private school	No. A	30	9,240	33.5	94.8	29.54	Clear day	Miller warm air furnace	Foul air vents and windows	Was not taken		65.0	67.0	68.5	74.5	69.2	74.5	61.2

Note 1.—Johnson system, with furnace in the basement in which was water pans to keep the air moist.

Note 2.—Used bottle for outside air.

SCHOOL ROOMS IN CLEVELAND, O.

19	March 9, 1891, 2 to 3 p.m.	Rockwell	No. 10.	51	10,192	41.0	48.8	29.25	Cloudy and spitting snow.	Steam radiators, with direct steam heat.	Windows and foul air vents	Could not determine.	Could not determine.	67.0	69.0	76.5	66.5	70.5	77.0	39.2
20	March 9, 1891, 3 to 4 p.m.	St. Clair Street	No. 12.	47	11,310	33.0	89.5	29.31	Cloudy and snowing.	Direct steam heat.	Foul air shafts connect'g with attic; fresh air from windows	Could not determine.	Could not determine.	67.5	71.5	77.0	67.2	70.0	85.5	39.8
21	March 10, 1891, 10 to 11 a.m.	Central High Sch.	No. 10.	54	17,280	41.5	40.1	29.68	Bright, sunny day.	Indirect steam	Ventilators, windows and doors.	Could n. t determine.	Could not determine.	69.0	72.0	76.0	68.0	71.5	76.5	27.0
22	March 10, 1891, 11 a.m. to 12 m.	Outhwaite School Building.	No. 11.	52	12,544	48.0	37.0	29.68	" " "	Indi ect steam	Cold air conduit, foul air vents, windows and doors.	Could not determine.	Could not determine.	66.5	67.0	74.0	65.0	67.0	76.0	24.0
23	March 11, 1891, 9.20 to 10 a.m.	Case Avenue	No. 12.	50	11,934	54.5	35.4	29.59	" " "	Indirect steam	Windows, doors, transom and foul air vents.	Could not determine.	Could not determine.	71.0	71.2	75.5	70.0	71.0	75.0	31.6
24	March 10, 1891, 2 to 3 p.m.	Scranton Street	No. 2	73	12,852	44 0	44.6	29.60	Clear, with sunshine.	Smead system	Smead system.	Anemometer disarranged; could not determine.		72.5	76.0	81.9	70.5	75.5	81.0	34.5
25	March 11, 1891, 2.15 to 3 p.m.	Sterling Ave. Relief House.	No. 22.	55	8,700	55.2	47.9	29.49	Clear and bright.	Ordinary stove	Windows, doors and transom.	Could not determine.		73.0	77.0	79.5	68.0	71.0	77.0	38.7

SCHOOL ROOMS IN COLUMBUS, O.

26	March 25, 1891, 2 to 3 p.m.	Fifth Avenue	No. 3	65	10,075	53.0	45.3	29.58	Bright sunshine	Smead System	Smead system.	Could not determine.	Could not determine.	67.0	68.0	69.5	68.3	69.0	70.1	45.9
27	March 26, 1891, 10 to 11 a.m.	Garfield Avenue	No. 11	59	11,492	44.5	56.5	29.34	Clear, turning to cloudy.	Direct and indirect steam.	Foul air vents, windows, doors and transoms.	" "	" "	63.5	69.5	77.0	60.0	64.0	79.0	53.9
28	Mar. 25, 1891, 10.30 to 11.30 a.m.	High School	No. 8	24	11,492	47.5	59.4	29.63	Bright, sunny day.	Smead system.	Smead system.									

Direct and indirect steam. . .	Foul air vents, windows, doors and transoms.			63.5	69.5	77.0														
Smead system.	Smead system.	"	"	64.0	68.0	56.2	65.2	66.5	56.1	52.7	42.4	39.1	48.7	43.2	39.8	4.291	12.830	15.772	9.239	15.031	15.695	13.561
Smead system.	Smead system.	"	"	66.0	67.4	74.0	67.5	67.3	72.8	45.0	44.1	29.9	42.0	39.8	31.2	4.291	13.551	15.772	10.350	18.697	13.648	13.056

SCHOOL ROOMS IN MANSFIELD, O.

See note 2.	See note 5.	Could not determine.	Could not determine.	69.5	72.0	76.0	65.5	67.0	74.5	41.6	41 7	35.8	53.9	52.5	38.1	4.728	16.251	14.430	15.131	28.281	19.792	25.690
Grossius system. Used two Stoves.	See note 6.	Could not determine.	Could not determine.	70.0	71.0	74.0	68.5	69.8	74.5	48.8	49.0	46.8	51.2	52.0	43.7	4.728	21.495	21.523	23.335	22.506	21.875	20.176
Grossius system ; one heater.	Windows, ventilators at floor, transoms and doors.	200 lin. feet one mom't, the next nothing.	80 lin. ft. one moment, the next nothing	63.0	65.0	85.0	67.0	72.5	90.0	47.0	46.4	21.1	45.9	40.1	17.5	4.728	18.821	21.742	24.727	17.547	17.475	15.671
Grossius system, one heater.	See note 7.	Could not approx'ate	Could not determine.	60.0	65.0	75.0	60.5	64.0	75.5	41.7	39.5	24.4	42.2	40.8	26.5	4.728	13.988	14.184	15.705	14.640	17.225	16.467
Grossius system, one heater.	See note 8.	Could not determine.	Could not determine.	64.0	66.0	84.5	61.0	65.0	83.0	36.1	38.2	17.5	45.2	39.5	18.7	4 728	15.869	16.949	16.038	17.967	18.755	18.426
See note 3.	See note 9.	30 cub. feet per min.	80 cubic feet per minute.	60.0	64.0	78.0	62.0	65.5	90.0	41.7	40 5	20.9	42.2	42.3	16.5	4.728	19.127	17.499	16.493	16.418	16.971	18.223
Steam, with open fire grate .	See note 10	Could not determine.	Impossible to calculate.	59.5	73.8	85.0	58.0	68.2	88.0	41.2	33.0	20.1	42.1	36.5	18.9	4.728	12.425	11.847	9.914	11.751	14.401	14.132
Smead System	Smead system, with six foul air ventilators at the floor.	51,400	32,400	64.0	69.5	78.3	64.0	66.5	77.0	36.2	29.5	12.9	34 0	30.2	16.6	4.728	12.626	14.901	13.552	Bottle broke.	10.016	12.783
See note 4.	None, except windows and doors.	Unknown.	Could not determine.	57.5	. . . .	92.5	59.0	. . . .	84.0	44.3	. . . .	18.8	45.8	. . .	25.8	. . . . .	11.104	9.855	10.416	16.098	15.391	13.406
One common ordinary stove.	Two registers 12x18 in., open in the ceiling.	Unknown.	Unknown . .	58.0	63.5	69.0	54.0	61.5	70.0	55.6	42.7	32.8	49.3	48.1	33.7	. . . . .	13.075	10.174	13.926	11.318	11.001	11.473

3. A and B, Secondary. 34. C and D Grammar No. 7. 35. C and D Grammar. 36. Children's Home. 37. II Division. 38. A single room country school. 39. Common country school.

om, which is so arranged as to bring a small supply of fresh air from the outside, and heat it as it passes through the stove, from which it is discharged into the room.
it and delivers it to the room the same as the Grossius system. Note 4.—A so-called Baxter sanitary stove, which took the air in from the floor, heated it, and discharged it back to the room from the top of the stove.
ansoms and doors used for the admission of fresh and the discharge of foul air. Note 6.—No ventilation other than that supplied by placing boards at the bottom of the windows so as to allow the ingress and egress of air between upper and lower sash.
the east, one on the south ; windows with 4-inch boards under them, allowing air to pass in and out between the upper and lower sash. Note 8.—Windows with boards under them, and register in side wall 14x18, two feet from ceiling on east side.
of the heater, and connecting with the smoke flue. Foul air ventilators about 14x4 inches were located around the room at the floor, which discharged foul air or admitted cold alternately, according to the movements of the air outside.
foul air duct in chimney. Windows with 4 inch boards under them, as already described. Door and transom.

MISCELLANEOUS OBSERVATIONS.

t bottom, the wind entered at the rate whilst the window on the north, which d an outflow of 360 linear feet a minute. th the foul air box that the in- and out- d with any degree of accuracy. Age of ears.

formerly heated by steam, but is now furnaces, eight in number, are situated lding, each one of which supplies three ir. Each room is furnished with a ther- ns of electric wires to the dampers of tructed as to be set to any desired tem- ilding was 72° F., and are so arranged exceeds that which they are set for, the ns of the electric wires, or when it falls ers are opened in a similar manner. On e are tw fresh air shafts that connect is brought in without heating. In the other ventilating shaft to carry off the these vents are always out of order they low ventilation, which they open every to purify the air. The opening at the d with a central air shaft, and wa- de- air; but being a failure, these registers ws depended on instead, of which there three inches at the top, and one open- ven accurately, but said to range from 6

room ; two cold air conductors in floor ; of room. Windows face west and north. ll ; two doors, one leading into hall and above door in hall ; doors and transom pen at top. Two foul air shafts, 12x12 inches. In other respects the room was g rding the ventilation. Age of pupils said to range from 6 to 9 years.

room fa e west ; one open at top, with ; two doors and transom closed ; very hrough the hot air register. Age of pu- ut said to range from 6 to 9 ye rs.

ned one large register in floo , 20x3 of fresh air. Two windows in back of to ; one window open at side of roo , g room ; two windows east, two windows n of tired feeling, probably due to the mpounds resulting from the unsanitary o ages given accuratoly, but range from

ing through grates in the floor for the n the outside. One ventilator near ceil- face east, two open one foot from top ; and three transoms in the room. With ting and ventilation was the same as already described r garding this system. Chemist did not give age of pupils accurately, but range from 6 to 9 years.

18.—This room was heated by an ordinary Miller furnace located in the cellar. Fresh air from outside of building was heated and delivered to rooms above. Two hot air registers in the floor, two foul air registers in back of room near floor. Room had seven large windows, all closed except one, which was open two inches from top. Age of pupils range from 13 to 20 years.

19.—The examination was made immediate y after a recess of two hours. Foul air shafts opened at the floor and connected with the attic, and from thence with cupola on top of building. Fresh air was supplied through open windows. In addition to the foul air vents at floor, there were two top ventilators. Four windows on south, two doors east, two doors west, one hall and window north, one ventilator south near floor, and one north near floor. Average age of pupils about 14 years.

20.—There were three windows north, three west, two doors east with transoms, one door and transom slightly ajar, three windows down from top on west, one foul air ventilator in floor on south, one north, and one west, 12x12 inches ; three steam radiators, one in the northwest, one in the southwest, and one southeast. Age of pupils about 10 to 12 years.

21.—This building was formerly heated and ventilated by the fan system, but owing to the noise and other imperfections, it was bandoned, and indirect steam employed, consisting of four steam radiators—two of which were shut off—over which the fresh air from the outside passed and was heated before entering the room. Four windows south, two east, lowered about six inches from top, two windows open in east about four inches from bottom, two windows on south open four inches from bottom. Two doors north with transoms. Age of pupils, 15 to 18 years.

22.—Four steam radiators in room, three south and one east, over which fresh air passed on its way into the room. There were also two cold air registers in the floor of the room, for the admission of fresh air. Cold air was passing over two of the steam radiators from the outside, three windows south open two inches from top and three inches below, two windows east both open two in. from top, and one open three inches from botton. Age of pupils about 12 years.

23.—This room was heated by three steam radiators over which the cold air passed on its way into the room. There were six foul air vents placed in the floor, 12x18 inches, which connected with a central air shaft, of which there are four in the building. These foul air shafts are h ated in winter by a furnace, and in summer by a small fire built at bottom of shaft. Four windows face south, three east, two doors north with transoms closed. All windows in south were open two inches from top, while all the windows had four-inch boards under them at bottom to allow the air to pass in and out between the upper and lower sash. Age of pupils, unfortunately, was not obtained.

24.—At the request of the principal the air in this room was investigated, as it contained the largest number of scholars, and was supposed to be the worst room in the building. There was one register 26x22 inches for the admittance of fresh air, and six outlets for foul air placed around the room at the floor, under the windows, that communicated with the ventilating shaft. Four windows north, all closed, two windows and two doors with transoms on the east, all closed ; fire in the furnace low, as the afternoon was qu te warm. Average age of pupils, six years.

25.—This room was ventilated with boards under the bottom sash, allowing air to pass in and out between the two sash ; two windows in west, one open four inches from top ; two windows south, closed ; two windows east, one open four inches from top. A Crown stove No. 8, made in Cleveland, was located in northwest corner of room. Age of pupils not given.

26.—Hot air ventilator 30x24 inches' with cold air turned on and hot air shut off, located on east side of room ; three foul air vents at floor on north side the same on the south side ; on west closed door and transom ; two open ways leading into closet containing one window facing north, all closed. Average age of pup ls, 7 to 8 years.

27.—This room was heated by one direct steam radiator on the west, with heat turned on, one on the east with heat turned on, one on south with heat turned on ; one indirect steam heater on the north, 14x14, coming through conduit from an indirect steam heating box in the cellar. One foul air ventilator in the wall near the floor on the north, 14x14, connecting with the foul air shaft shaft leading to the cupola ; two windows east and three south, all open from the top ; two doors leading into a closet north. When windows are open foul air vent does not work. The fresh air is kept shut off of indirect radiator in the cellar, as they could not heat the building when the fresh air was turned on. Consequently fresh air had to be obtained through windows.

28.—While in this room door was opened and closed three times. Five foul air vents on the west with only one open and four closed with sheet iron; three foul air vents south, one open and two closed with sheet iron; two foul air vents east, both open, four windows west, all closed, two doors north, closed, one large fresh air vent, about 26x22, on the north ; chemist does not report whether open or closed. Average age of pupils, 18 years.

29.—Hot air coming thr ugh ventilator, 18x32, on west ; three windows east, three windows north, three foul air vents at the floor north, one foul air vent in closet, two doors open leading into closet on the west, three foul air vents at the floor east, one door with transom closed on the south. The chemist failed to give the age of the pupils in this school.

30.—On north side no foul air vents. On east side an open air ventilator. On west side three foul air vents bottom of wall. On south side the same. There were two doors with transoms on north side, with one transom and a door and a window open, one door on east side, with transom open and two windows closed. Two windows open on west side with 4 in. boards under them, and three open in the same manner on the south side. These boards were so arranged as to allow the fresh air to pass in or out between the two sash. The age of pupils varies from 15 to 18 years.

31.—There was no provision for ventilation except windows and transoms and a hole 2x2 ft. in ceiling, the latter of which was closed. There was two windows on the north, two windows and one door and transom on the east, three windows one door and a transom on the west, and two windows on the south. Windows were boarded at bottom same as above. Age of pupils ranged from 14 to 18 years.

32.—Ventilation bad. Nauseating odor in room. Two doors at south side with transoms, doors closed and one transom open. One door and transom on the north side, closed. Six windows in the room with 4 in. boards under four of them. One ventilator 12x18 in wall at level of floor for escape of foul air. Two ventilators similarly situated, 12x18, but furnishing cold air. Age of pupils 8 to 10 years.

33.—Two doors with transoms, north. Two windows east, two west, two south, which have 4 in. boards at bottom to allow air to pass in and out between the sash, and the three ventilators at the ceiling open. Age of pupils 10 to 12.

34.—This room contained two doors with transoms on the north, two windows on the west, two east, two south. One window on the east open about 18 in. from below. The others, with boards under them, allowing the air to pass out between the sash. Age of pupils 14 to 15 years.

35.—At the northeast corner of the ceiling there was about four square feet of plastering off, making a free communication between the room and the garret. This room had nine windows, and two doors with transoms. Six of the windows had 4 in. boards under them, as already described. No calculation was made of the air passing in and out of these windows or the hole in the ceiling. Average age of pupils about 13 years.

36.—One door with transom on west, two windows north, three east, two south. One window with 4 in. board under it. Transom over door open. Average age of pupils about 10 years. Examined tion very shortly after a recess of twenty minutes.

37.—This room was literally crowded with scholars about the age of 12 years, and too many scholars for the size of the room. A slight offensive odor, which I think was largely due to the unsanitary condition of the pupils, was observable. Two doors, one north and one west, both closed, several sliding windows on the south, all closed. Additional heat was turned on by the superintendent just as we started to take the temperature, which no doubt accounts for the increased temperature at the ceiling in this case, as the air had not had time to circulate through the room thoroughly before we had completed taking temperature.

38.—This building stands out in a field upon a small hill, unprotected. Stove in centre of the room. One window pane broken out on west side. Three windows north, one door and window east, three windows south, and two windows west. Strong west wind blowing. Average age of pupils about 14 years.

39.—School building located on a hill protected by a grove on the north. No wind stirring; no means for the admittance of fresh air except through the cracks of the doors and windows. Two doors on the south with transom over each. Three windows on the east and three on the west. Stove situated in middle of the room. Average age of pupils about 14 years.

Notwithstanding the variations ... the same ... lar system ... has been ... On the ... circulating ... markable ... the amount ... different ... different ...

ent time, wh... large quant... school-room... their theorie... evidence to ... We must ... large quanti... any physica... observed by ... It is true ... produce fata... and no dou... mense quant... rooms; but ... a large majo...

...ton of State Medicine of the American Medical Association for the Meeting held in Washington, D. C., May 5 to 8, 1891.

...Mansfield, O., assisted by Prof. Louis Schmidt, B.Sc., Chemist (Mass. Institute of Technology),

SCHOOL ROOMS IN CINCINNATI, O.

Kind of Heating Apparatus in use.	System of Ventilation Employed.	No. cubic ft. of fresh air supplied per hour.	No. of cubic ft. of foul air discharged per hour.	Temperature Front of Room.			Temperature Rear of Room.			Humidity front of Room.			Humidity Rear of Room.			Amount of Carbon Dioxide found in the air of the city per 10,000 parts.	Amt. Carbon Dioxide per 10,000 parts front of room.			Amt. Carbon Dioxide per 10,000 parts rear of room.		
				At the Floor.	At the Mouth.	At the Ceiling	At the Floor.	At the Mouth.	At the Ceiling	At the Floor.	At the Mouth.	At the Ceiling	At the Floor.	At the Mouth.	At the Ceiling		Level of Floor.	Level of Mouth.	Level of Ceiling.	Level of Floor.	Level of Mouth.	Level of Ceiling.
Smead system	Smead system	57,420	Could not determine.	70.2	71.5	72.0	69.8	69.6	71.3	28.5	31.6	22.9	29.2	33.0	23.5	6.038	11.102	13.970	16.610	14.658	12.228	13.377
Smead system	Smead system	44,040	Could not determine.	64.0	69.2	69.0	65.5	65.6	68.5	38.5	26.8	27.0	40.0	44.5	32.4	6.038	13.039	14.187	16.037	19.388	16.765	19.228
Smead system	Smead system	4,740	Did not determine.	73.5	73.5	74.5	74.5	73.2	75.0	63.2	63.1	67.9	61.6	68.2	61.9	6.038	14.765	14.361	14.244	16.892	16.718	17.540
Smead system	Smead system	4,740	Not determined.	71.5	72.0	73.5	73.0	72.8	74.2	69.8	68.9	63.0	67.3	65.8	60.9	6.038	15.700	14.455	15.122	15.920	16.298	16.940
Smead system	Smead system	6,360	Did not determine.	69.0	66.5	70.0	67.5	66.3	69.2	67.4	76.3	65.8	69.2	73.8	67.6	6.038	13.770	14.217	12.682	12.500	13.581	13.655
Smead system	Smead system	14,340	Did not determine.	68.5	68.5	71.0	62.5	63.0	63.5	97.3	97.3	97.5	97.1	97.9	91.6	6.038	10.760	11.255	11.049	11.750	11.210	10.824
Grossius heater in the room, ordinary furnace for halls.	Foul air vents, windows and doors.	Could not determine.	Could not determine.	69.5	65.2	68.0	67.5	65.1	67.0	67.8	44.1	40.5	66.5	48.7	41.5	6.038	12.610	11.520	12.501	14.030	11.091	10.690
Grossius system same as above.	Foul air vents, windows, doors and transoms	Could not determine.	Could not determine.	63.0	63.1	68.5	63.5	66.3	69.0	37.5	45.2	32.4	40.3	41.5	37.0	6.038	9.088	Lost . .	15.031	8.630	9.322	12.720
Grossius system same as above.	Same as above	No approx. est. made	No approx. estim. made.	65.5	66.0	69.0	67.1	67.0	68.5	49.1	45.0	43.2	46.2	45.9	40.7	6.038	10.468	11.240	11.340	11.417	10.400	10.310
Grossius system same as above.	Same as above	No estim. given.	No estimate given.	64.3	66.3	74.0	66.2	67.5	73.5	48.2	45.9	35.8	46.2	44.1	37.2	6.038	8.815	Bottle broke	11.392	8.742	See note 2.	9.182
Same as above	Same as above	No estim. given.	60,000	72.3	73.5	71.5	73.5	74.0	75.5	62.5	57.6	66.5	56.9	54.2	52.2	6.038	8.324	10,768	10.111	8.599	7.738	7.991
Same as above	Same as above	Could not accur. deter	Could not accur. deter.	72.0	71.0	72.5	70.1	71.0	72.9	53.9	61.8	56.3	61.3	59.6	55.2	3.494	6.741	Not taken	7.196	7.142	7.261	7.430
See foot note 1	Foul air shafts, windows and doors.	Could not determine.	Could not determine.	71.5	72.0	74.5	72.0	72.1	73.5	57.9	58.2	55.1	53.9	55.9	54.8	7.395	13.835	12.264	11.843	12.441	Lost.	10.672
Same as above	Same as above	Same as above.	Same	71.8	70.0	73.0	71.0	70.0	72.5	54.5	63.5	52.5	55.3	59.0	53.0	7.308	9.669	10.158	9.896	8.757	9.178	10.025
Same as above	Same as above	Same. . .	Same	68.0	67.5	69.1	67.2	68.0	69.2	36.0	40.5	39.2	40.2	44.5	41.1	7.308	13.509	13.291	13.482	12.320	12.511	12.280
Same as above	Same as above	Could not measure on account of variable currents		64.5	68.0	73.5	66.0	68.5	72.0	55.3	51.1	33.9	54.3	51.5	41.7	4.739	10.618	11.627	11.501	10.230	Did not take.	11.106
Same as above	Same as above	Same as above.		67.0	68.3	71.0	68.2	69.4	70.5	41.5	40.5	33.0	40.1	37.5	34.4	4.981	14.130	16.991	16.150	15.741	Did not take.	15.780
Miller warm air furnace . . .	Foul air vents and windows .	Was not taken		65.0	67.0	68.5	74.5	69.2	74.5	61.2	41.5	49.2	25.6	38.8	24.8	5.181	14.392	Not taken	13.682	13.286	Not taken.	14.221

to keep the air moist.

Note 2.—Used bottle for outside air.

SCHOOL ROOMS IN CLEVELAND, O.

Steam radiators, with direct steam heat.	Windows and foul air vents .	Could not determine.	Could not determine.	67.0	69.0	76.5	66.5	70.5	77.0	39.2	39.1	27.6	45.4	34.4	28.1	5.006	17.560	16.997	14.085	15.550	17.160	15.277
Direct steam heat.	Foul air shafts connect'g with attic; fresh air from windows	Could not determine.	Could not determine.	67.5	71.5	77.0	67.2	70.0	85.5	39.8	39.3	31.4	32.9	35.9	24.1	5.006	14.401	16.753	17.505	17.792	14.156	14.682
Indirect steam	Ventilators, windows and doors.	Could not determine.	Could not determine.	69.0	72.0	76.0	68.0	71.5	76.5	27.0	26.5	19.8	38.1	33.5	21.0	5.006	11.872	11.850	10.760	12.881	14.731	16.275
Indi ect steam	Cold air conduit, foul air vents, windows and doors.	Could not determine.	Could not determine.	66.5	67.0	74.0	65.0	67.0	76.0	24.0	28.7	23.2	35.1	32.9	20.4	5.006	6.694	7.065	11.181	9.658	12.421	10.650
Indirect steam	Windows, doors, transom and foul air vents.	Could not determine.	Could not determine.	71.0	71.2	75.5	70.0	71.0	75.0	31.6	33.0	16.6	32.0	33.6	24.4	5.006	7.698	9.756	10.001	8.181	10.268	9.363
Smead system	Smead system.	Anemometer disarranged; could not determine.		72.5	76.0	81.9	70.5	75.5	81.0	34.5	32.2	22.0	32.5	28.3	21.1	5.006	15.450	12.175	11.425	14.221	11.582	15.392
Ordinary stove	Windows, doors and transom.	Could not determine.		73.0	77.0	79.5	68.0	71.0	77.0	38.7	36.7	27.2	44.5	45.1	31.4	5.006	13.872	12.378	11 392	15.911	13.127	15.733

SCHOOL ROOMS IN COLUMBUS, O.

Smead System	Smead system.	Could not determine.	Could not determie.	67.0	68.0	69.5	68.3	69.0	70.1	45.9	42.4	43.7	38.1	43.2	42.0	4.291	14.220	15.328	15.102	12.899	12.765	14.300
Direct and indirect steam. . .	Foul air vents, windows, doors and transoms.	" "	" "	63.5	69.5	77.0	60.0	64.0	79.0	53.9	45.7	31.4	39.2	38.5	31.7	4.291	10.705	11.253	10.222	10.252	10.285	9.751
Smead system.	Smead system.	" "	" "	64.0	68.0	56.2	65.2	66.5	56.1	52.7	42.4	39.1	48.7	43.2	39.8	4.291	12.830	15.772	9.239	15.031	15.695	13.561
Smead system.	Smead system.	" "	" "	66.0	67.4	74.0	67.5	67.3	72.8	45.0	44.1	29.9	42.0	39.8	31.2	4.291	13.551	15.772	10.350	18.697	13.648	13.056

ture *increases*. Yet this condition is very greatly modified by the humidity of the outside atmosphere. For example, take a wet, sultry day, when the humidity of the external air is almost at the point of complete saturation, and at the same time the outside *temperature so high*, that but little artificial heat is required, or can be tolerated, the humidity will be found to be exceedingly high in the school rooms, as a natural result of a combination of circumstances. Again, with the same degree of humidity outside, associated with a *cold raw air* requiring a considerable quantity of artificial heat to make the school room comfortable, the humidity of the school room, whilst somewhat high, will be found much lower than under the former conditions; and at the same time the average temperature will be almost or practically the same.

You will observe by table No. 4, that the average humidity at the floor in front of the school rooms, in the various systems varies from 27.5 to 61.2; whilst at the mouth it ranges from 29.4 to 50.7; and at the ceiling from 19.8 to 49.2. At the rear of the room, it varies at the floor from 25.6 to 50.8, whilst at the mouth it ranges from 33.3 to 51.5; and at the ceiling from 16.5 to 45.0.

By these you will observe that even many of the general averages are entirely too low, although few of them are found to be too high. Yet, notwithstanding all this when we examine the itemized charts and study the individual results in isolated cases, you will find still greater variations of the humidity, in different parts of the same room; and especially so when no regular system of circulating and changing the air has been adopted.

On the other hand, when a regular system of circulating the air has been adopted, it is remarkable how the results are modified regarding the amount of moisture contained in the air at different points in the same room, and even different rooms in the same building.

CARBON DIOXIDE.

Notwithstanding we have advocates at the present time, who question the injurious effects of even large quantities of carbon dioxide in the air of school-rooms, yet I am not prepared to accept their theories, without more than circumstantial evidence to verify their correctness.

We must bear in mind that the presence of large quantities of CO_2 does not necessarily make any physical changes in the air that are readily observed by the senses.

It is true that immense quantities of CO_2 will produce fatal asphyxia, yet it never has been, and no doubt never will be found in such immense quantities as to produce death in school-rooms; but it *is* found in sufficient quantities, in a large majority of school-rooms, as to act as a slow poison from day to day, during a large portion of the scholars' school life, in proportion to the quantity of CO_2 present, and the corresponding restrictions on the natural supply of fresh air.

The question of where the carbon dioxide prevails in the largest quantities, in school-rooms, has long since been a mooted question. The old authors, as well as public opinion, placed it at the *top* of the room; and as a result of their belief, advised making provisions for its escape at or near the ceiling. On the other hand, the more recent writers affirmed that it prevailed in the greatest quantities at or near the *floor*, of a given room; and cited you to the fact that it was heavier than air, and of necessity must accumulate at the bottom; and produced as evidence to prove their theory, the old cave story—in which a man can walk with impunity, while his dog would be asphyxiated with carbon dioxide, which they backed with the experiment of the model house, in which a large, medium, and short lighted candle was placed, and the air excluded—when the short candle would go out first, the medium next, and the long candle last.

But you must remember that in neither of these cases, is there any circulation of air, and consequently, barring the law of diffusion of gases, there is nothing to intermix the CO_2 with the sundry stratums of air, and modify the natural laws of gravitation. On the other hand, we have quite a different condition of affairs in the school-room, which modify the primary laws of gravity, and which give us entirely different results than the imaginary attributes from which we have heretofore woven our theoretic web of supposed conditions regarding the CO_2, which, however, in fact did not exist, as you will observe by a careful study of the charts and tables which accompany this report.

By turning to table No. 6, you will observe that the highest average of CO_2 found associated with any particular system of heating and ventilation, in the *front* of the room at the level of the floor, was 19.127 parts per 10,000, and the lowest average was 8.754; whilst at the *mouth* the highest average was found to be 17.499, and the lowest at the same level was 9.557; and at the *ceiling* the highest average was found to be 16.493, and the lowest 9.914; which only shows a difference of 1.160 parts in 10,000, between the lowest average at the floor and the lowest average at the ceiling, in favor of the ceiling; and only 2.634 parts between the highest average at the floor, and the highest average at the ceiling, in favor of the floor.

Again, in the *rear* of the room, the highest average of CO_2 at the floor was 16.671, and the lowest 10.240; whilst at the mouth it was 16.971 against 10.285, and at the ceiling 18.223, as compared with 9.751; with only a fraction of .489 difference between the lowest average at the

mouth and the lowest average at the ceiling, in favor of the latter; whilst the difference between the highest average at the ceiling, and the highest average at the floor, was only 1.552 in favor of the ceiling. But go with me, if you please, to table No. 5, and there turn to the grand average of the four cities, taken from 224 determinations, and you will find that there is only a fraction of a difference between the amount of CO_2 at any level of the room, either at the rear or front; which grand average shows in the front of the rooms 13.137 at the floor, and 13.785 at the mouth, and 13.064 at the ceiling. Whilst in the rear of the rooms, it shows 14.350 at the floor, 13.651 at the mouth, and 13.912 at the ceiling; or in other words, only the fraction of .075 difference between the floor and the ceiling in the front of the rooms, in favor of the floor; and but .438 difference between the floor and the ceiling at the rear of the rooms, in favor of the former.

It seems to me that this investigation ought to settle, without a question, the problem regarding the location of the CO_2 in the school-rooms of to-day, and especially those which are heated artificially, and to prove beyond a shadow of a doubt, that CO_2 is an omnipresent factor, in practically the same relative proportions at all levels of a school-room, whether ventilated at the top, sides or the bottom, or all.

GENERAL REMARKS.

The next important question that confronts us, after having obtained all this "array of facts and figures," is—how shall we proceed to heat and ventilate our school rooms in the most sanitary, economical, practical and scientific manner? In answer to these questions I will say:

1st.—That to heat and ventilate our school-rooms in the most *scientific* manner will require a system of heating and ventilation which will avoid the necessity of having either open doors, windows or transoms, and which will at the same time supply each scholar with not less than 1,000 cubic feet of fresh warm air every hour, and which will remove a corresponding quantity of foul air at the same time, without subjecting any scholar in the room to an uncomfortable draught of either cold, or over-heated air. Sufficient fresh warm air should be supplied to each scholar, at an average temperature of about 70°, and an average humidity ranging from 40 to 50; whilst the foul air should be removed sufficiently rapid as to prevent an accumulation of CO_2 to exceed 10 parts in 10,000 parts of air at any time, or in any part of the room, or a variation of the temperature between the floor and the ceiling to exceed 10° Fahr., or at any level of the same between the front and the rear, or either, to exceed 5° Fahr.

2nd.—To accomplish these results in the most *economical* manner will require an air warmer, with sufficient capacity to heat the required amount of air to the desired temperature without superheating it (for under no circumstances should it be allowed to pass over red-hot iron plates); and which fresh warm air should be discharged in a gentle current at the floor, and exhausted at the same level at the sides of the room, without the assistance of a top ventilator or the aid of an open door, window or transom. But if top ventilators *are* used at all, they should only be used to cool the room, in the event it became *over* heated from any cause; outside of this they are of no value whatever, except to wantonly waste our heat and fuel, without giving us any advantages in return for their loss.

3rd.—I am fully aware of the fact, that it is usually a very difficult task to realize, in a practical manner, the theories that fill us with enthusiasm when demonstrated on paper; and further, that there is perhaps *no* system of heating and ventilation in use at the present time, that is capable of carrying out in every particular, under all possible circumstances, the ideal heating and ventilating of the average school-room, yet after years of investigation, and examining scores of different kinds of heating and ventilating apparatus, without "either fear or favor" to any one, I am thoroughly convinced that there is no system of heating and ventilating at the present time, that will come so *near* fulfilling the requirements of the ideal methods of accomplishing these results, in the most sanitary, economic, practical and scientific manner, as the so-called Smead system. In making the above assertion, I do so in all candor, and without personal favor, or intentional disparagement to any one, but simply as the legitimate conclusion I have derived from actual facts, obtained from repeated personal and scientific investigations.

CONCLUSION.

I trust you will pardon the prosy character of this report, which is largely composed of "facts and figures," which to obtain, has been a tedious, irksome, and an expensive task. Yet if only it serves the purpose of securing a better heated, and more liberal supply of God's pure air to the rising generations, who spend (from a hygienic standpoint at least) the very best and most important part of their lives in our public and private schools, I will feel that all my labors have been fully repaid.

Mansfield, O., April 27, 1891.

KATZENJAMMER.—Resorcin is said to act admirably in cases of nausea and depression following a carouse. It is given in the dose of from five to ten grains in plenty of water, flavored with syrup of orange peel, and may be repeated once or twice at intervals of half an hour. A single dose of ten grains is, however, said to be usually sufficient.—*N. Y. Med. Record.*

THE VALUE OF WEAK CYLINDERS FOR THE RELIEF OF EYE MUSCLE STRAIN.

Read in the Section on Ophthalmology, at the Forty-second Annual Meeting of the American Medical Association, held at Washington, D. C. May, 1891.

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Three years ago I read a paper before the ophthalmological section of the American Medical Association, on the value of 0.25 D. cylinder in the correction of the lesser grades of astigmatism. My additional experience confirms the position which I then took.

The annoyance occasioned by eye muscle strain demands recognition from complaining patients whose heads will ache when the eyes are much used. All astigmatic eyes do not suffer in like proportion. There are three factors at work that bring about annoyance. The first is the amount of eye work required by a badly shaped cornea; a second factor is the degree of fault; and a third is found in the nervous susceptibility of the patient.

As to the first condition, the amount of work required. The majority of astigmatic eyes only exhibit the trouble under forced application. Eyes which have done faithful and painless duty for many years are suddenly called upon for an unusual effort. They break down with pain, which then returns upon moderate use with a persistency that makes eye work unsatisfactory, and the individual miserable. The defect had always existed, and would not have been brought out had the additional labor not been undertaken. This is constantly illustrated in over worked advanced school children at examination periods. They complain of painful eyes and head from the too close application, when their parents, who exhibit the same degree of irregular refraction, have never suffered. This complaint is especially made if the young patient is of the nervous type, is rapidly growing, and is more anxious to secure good school grades than to take open air exercise. Hence girls suffer more than boys.

Physicians are seldom consulted by healthy people who have no physical complaints; and likewise ophthalmic surgeons only see those whose eyes are not comfortable. Such eyes are not necessarily inflamed; nor is there always dull vision. Most frequently the eyes themselves look in every way well, but with the inability to use them with comfort. The majority of those who consult me for painful eyes and head see clearly, and so state promptly: "It is not that my eyes are not sharp seeing, for I can see any small object that any one else can see, but they are not comfortable under use and my head aches when I read."

These two facts are daily noticed. So constant are they complained of that rarely do I not find irregular refraction when these symptoms are present, headache being the chief. My experience enables me to formulate, at least for my own guidance, this axiom: *Headache under eye use, with acute vision, in by far the majority of cases, means astigmatism, and usually of low degree.* If the irregularity of the cornea is not detected, it is because it has not been carefully sought for. It also means that the headache under eye use will not be relieved by any eradication or course of treatment until this irregularily of refraction is found and corrected.

Many specialists act upon the belief that V. $\frac{20}{20}$ is incompatible with annoying irregular curvatures in the cornea, and that it is needless to seek for astigmatism in such eyes. In cases of eye pain with acute vision their attention is therefore diverted from the true cause of the eye trouble to the examination for irregular action in the socket eye muscles, of which there is endless variety both in eyes that give no trouble and eyes that are painful. I find V. $\frac{20}{20}$ in one-third of my astigmatic cases; and this good vision among my most suffering patients. The most marked relief, and the most brilliant results from the adjustment of cylinder glasses I obtained among this class. Many of them had been under treatment by specialists and were wearing spherical lenses for near work but with no comfort. These cases are often mistaken for accommodative faults, formerly known as muscular asthenopia, and for which 1. + D. was the best known remedy. In former years I prescribed such glasses fifty times where I now have occasion to prescribe them once.

I often wonder what has become of the hosts of hyperopic eyes that I formerly saw and treated with spherical convex lenses. That I see the same character of eyes now I am quite sure, but no longer from the same standpoint. A more careful examination proves these cases to have been mild grades of astigmatism, often myopic. The same class still come to me from other specialists who are holding the views that I formerly acted upon, before I found out my mistake.

Years back I became aware that the most annoying irregularitics of the cornea are the slight deviations, which are still compatible with sharp vision, V. $\frac{20}{20}$ or $\frac{20}{30}$, seldom less than $\frac{20}{40}$, and frequently the greater fault in one eye only. In my most ailing patients I so constantly find the lesser irregularities that I have been forced to the conclusion that in the high degrees of astigmatism the eye ceases to make the effort for acute vision, recognizing its inability, and hence the less muscular strain, and consequently less headache. In the small irregularities of corneal curvature, headache on eye use is the most constant and conspicuous symptom. It is more common than eye

ache although the two usually go together. When patients with refractive errors consult me complaining of defective sight and no pain in the head, as a rule astigmatism is either excessive or I find none of it. I accept as a most valuable aid in the search after astigmatism persistent headache on eye use. As I have previously said the reading of Jager No. 1, with V. $\frac{20}{20}$, by such patients are to me no evidences that a painful degree of astigmatism does not exist. With this acute vision patients with over-strained eye muscles often cannot read with comfort ten minutes, day-light even annoys, and fixation for a short time, as looking into the face of a friend while conversing or into the plate while eating, excites nausea.

In the casual examination of these patients, some of them at first see no difference in the tinting of the lines on the clock dial chart. They will repeatedly say, "I see no difference whatever, in the color. To me they are all exactly alike." This would look as if there was no astigmatism. After these repeated trials and assurance, most examiners would abandon the idea of irregular refraction. But I say to myself "here is a case of headache on eye use for near work. This patient, feeling well, can soon read herself into a headache. In my experience a low degree of astigmatism is by far the most painful source of this discomfort. I will continue my search until I feel assured that it does not exist." By perseverence in the examination of one eye at a time, I will eventually get out of the patient that all the clock dial lines are not exactly of the same tint. Some will now have a slight grayish, bluish or brownish tint, which was not perceptible at the first examination of the card. Once they detect the difference they never afterward lose it. Some lines now are not as clean black as other lines, and a weak cylinder will clear all up better than the duplicate number of a weak spherical lens. Some patients will persist in the statement that there is a uniformity in color for all the lines until homatropia is used, when the slight difference which is the cause of all the eye trouble is discovered. The adjustment and wearing of proper cylinders, 0.25 D. + or —, will promptly put an end to the eye and head discomforts which had been the torment of the patient for months or even years.

In my case book hundreds of such patients have been entered; persistent headache on eye use, the constant complaint; a low degree of astigmatism always found; a 0.25 D. cylinder prescribed with the result of treatment recorded at varying periods, days, weeks or months after the glasses had been given. "No headache since I have worn the glasses except on the occasion when I tried to read without them." By the wearing of these weak cylinders of 0.25 D., in numbers of cases patients have suddenly jumped up from ten minutes reading with pain, to many hours continuous reading without any head discomfort whatever.

I will give but one illustration from among this very numerous class of recorded cases, because, on account of her professional history, it was of more than usual interest. The young lady was from New York City, was 18 years of age and well developed. She had been under more or less constant treatment on account of eye discomfort for five years, and had been removed from school because she could not study without pain in the head. When the first consulted ophthalmic surgeon who had her case under observation, had exhausted all theories and treatment with no relief, and had finally found weak recti muscles for which he advised tenotomy, the father refused to have any operation performed. The young lady, after an interval and still suffering, was put under the care of a second specialist. Guided by the experience of the first, as related by herself, he sought diligently to procure her relief. One by one all remedies were tried. Spherical lenses, practicing with prisms, internal medication, rest, but all with no benefit. When he had exhausted his resources he also suggested muscle cutting as the only untried remedy. He thought that relief would come surely through this surgical treatment. The father again declined to permit any operation. In the course of time this healthy looking girl, under blue glasses, was brought to my office for treatment. Her vision was $\frac{20}{20}$ and for one or two minutes she could read No. 1 of Jager. She was one of those who insisted that the test lines were all of uniform color, but she suffered with more or less constant headache. Under homatropia, horizontal lines seemed a little shady but not markedly so. Still she prefered a 0.25 + C.O. to a 0.25 + S in brightening up the entire face of the card. When the effects of the mydriatic had passed off, although the lines had again resumed their uniform brightness, she found relief in a 0.25 — C 90° rather than 0.25 + C.O. She was ordered the weak concave cylinder for constant wear. Before two weeks had passed by she could read for hours, night or day, with no discomfort whatever. Her headache returned whenever, for experiment's sake, she would put off her weak cylinder glasses, even for a short time. The relief from suffering was positive and permanent. I had a visit from the young lady one year after I had first seen and adjusted glasses for her. She still wore the weak cylinders and had no trouble whatever. She had resumed her education and as a diligent student was making up for lost time.

The necessity for recognizing the lesser degrees of astigmatism forces itself upon me daily. Long continued and persistent headache with eyes paining on use, uninfluenced by rest, medi-

cation, or hygienic influences, and relieved at once by a 0.25 D.C., ought to be proof enough of the necessity for discovering these low degrees of deviation from the true corneal curves. In many sensitive persons the verification of the diagnosis and the advantages of the treatment to the comfort of the individual are conspicuously shown when the cylinders are suddenly reversed. Pain and head discomfort seem immediately brought on by the mal-position of the axis of the lens. Then the restful condition when the cylinder is placed at the proper angle in the trial frame.

This 0.25 C. not only makes good vision easy, but often will make faulty vision good. All eyes needing a 0.25 C. have not necessarily $\frac{20}{20}$ V. Some exhibit only V. $\frac{20}{40}$, and yet this weak cylinder will enable them to see clearly the 20 line at 20 feet. This is curiously shown in eyes of the same individual which differ in visual acuteness, one eye may measure $\frac{20}{30}$ and the other only $\frac{20}{40}$ and yet each is made $\frac{20}{20}$ by the 0.25 cylinder. In another series of cases one eye will exhibit $\frac{20}{20}$ with all lines sharp, the other $\frac{20}{30}$ with one series of lines more distinct. The 0.25 C. will bring the dull eye sharply up to the normal, and the same glass will brighten up the whole picture when placed before the eye which without homatropia indicated no astigmatism. Should the cylinders be reversed, however, in the good eye irregularity in the blackness of the lines would at once show itself, in evidence that the small degree of fault was being concealed by the eye muscles. It would come out, in spite of muscular effort to the contrary, when the fault was doubled by the wrong position of the cylinder.

I daily see persons who, in giving their history, can fix the time from which their head and eye discomforts started. Up to a certain period they had used their eyes with comfort. Then came a sudden demand for closer application and with it the trouble commenced. As the astigmatism is usually a congenital fault, it must have always existed, therefore, notwithstanding the astigmatism, the eyes had been comfortably used in moderation. We also often find that when some extra work had increased the eye strain and made the head ache, the rest given by the temporary wearing of a cylinder would in time enable the astigmatic eye to do without the spectacle provided no unusual eye effort be again made. With young ladies it is no uncommon occurrence to find cylinders discarded at the end of school life, at least by those with whom the demands of society allow no time for close eye work.

We consider the shape of the eye ball as much a feature to be inherited as the shape of the ear, nose or mouth, with this important difference, that whether the nose is pointed or stumped we can smell with it equally well, but should any deviation occur from the typical shape of the eye ball, interference with vision is the consequence. These deviations in the eye shape are the rule. A perfectly formed eye in these days is as much an exception to the typical shape as a beautiful face is to the average citizen. Hence it is that I find astigmatism extremely common. With those who must apply themselves to close work, it is the common cause of head discomforts, which can only be relieved by rest, and this class can not afford it, or by the wearing of cylinders, which is now within the reach of everyone.

We often find a patient prompt in accepting or rejecting one of two cylinders that differ in strength a 0.25 D. There are some ophthalmic surgeons who will permit an eye to vary from a 0.5 to 0.75 and know that they are giving an immense degree of comfort to their patients by recognizing this difference. These very surgeons repudiate the ability of an eye to determine between a 0.5 and 0.25. The eye accepts the 0.25 C. but the surgeons have drawn the line of the 0.5 C., and avow they will never prescribe a glass that is weaker. The result is that some one else will have to do it. I find myself applied to by persons coming from other specialists with the 0.5 D.C. with head discomforts unrelieved, who secure freedom from headache and the ability to use their eyes with comfort when the cylinder has been reduced to 0.25. I so often find the use of a 0.25 D.C. making the difference to the wearer of from not being able to read a few minutes without headache to reading for hours with no headache, that I expect to secure these good results in prescribing them.

Another very common experience with me is that persons who suffer with persistent headache and hardly remember the day that they have been free from it, secure relief from the day that the 0.25 D.C. was first put on.

In the last four years I have been using the 0.25 D.C. more and more frequently. To give some idea of the number of 0.25 D.C. which I prescribe I find that last year alone I gave them to over three hundred private patients, and in hospital practice to fully as many more, so that in one year over six hundred pairs of 0.25 C. have been prescribed through myself alone. The uninitiated would say that in many of these cases the glasses must have amounted to nothing. That suggestion is promptly met by this counter-statement, all of these persons, mostly young students, bookkeepers or sewing girls, suffered more or less severely with headache and eye pains on eye use and they had applied for special treatment with the hope of getting rid of their annoyance. As with them all close application was a necessity, they all suffered from their daily work.

In all of these a small degree of astigmatism was found, which a 0.25 C. D. completely corrected. The fault was most frequently in the horizontal meridian, next in frequency in the

vertical and least frequently in the oblique diameters of the cornea. As a rule the annoyances were greatest when the faulty corneal curvatures were obliquely placed. The 0.25 C. gave the relief sought, in by far the majority of these cases. In many of these persons whose history could be traced, perfect relief continued with the use of these weak cylinders.

I have formulated for myself in office work this order. When a young person with no eye congestion who has $\frac{20}{20}$ vision and reads readily No. 1 of the test types, complains of pain in eyes and head on use, so convinced am I that astigmatism is at the bottom of the trouble that I seek it at once, in the very beginning of the eye examination. If it had not been found by others it is not because it did not exist, but because it had not been diligently sought. That a great many of these patients would exhibit heterophoria from the fixed standard of muscular strength, I am quite convinced. I find in by far the majority of cases with the correction of the astigmatism all evidence of muscle straining passes off, and in such patients the heterophoria does not call for recognition, because it no longer annoys when the cylinders are worn.

The least degrees of astigmatism cause in the world the greatest amount of head and eye discomfort, and the 0.25 C. will correct these refractive errors and will relieve head and eye pains. I not only therefore say that the weak cylinder ought to be prescribed, but that the ophthalmic surgeon is remiss who does not seek, find, and correct these small but annoying errors in corneal curvature.

DISCUSSION.

DR. J. L. THOMPSON spoke of a case in which 0.25 D. gave relief when 0.50 D. did not.

DR. F. C. HOTZ said he often finds cases of a low degree where cylinders do not relieve the asthenopia. In these cases the asthenopia is due to heterophonia.

DR. T. E. MURRELL called attention to an unaccountable condition frequently observed by him, viz.: two eyes having an equal degree of astigmatism but with very unlike vision uncorrected, one being sometimes doubly as acute as the other, but both having equal vision with the same correcting glass.

DR. GEORGE T. STEVENS: There appears to be no difference of opinion in respect to the correction of practical degrees of astigmatism. The question is, what constitutes a practical degree of astigmatism? The judgement of the surgeon must determine whether an amount of astigmatism bordering upon perfect or practically perfect refraction is to be regarded as an amount which will require the use of glasses which by their mechanical objections are irksome to the patient.

The physical condition of the patient, the form of astigmatism, and various conditions must guide us in determining the prosperity of a constant correction of vary minute degrees of astigmatism.

DR. BURNETT, of Washington, said the normal astigmatism was at least 0.25, but that undoubtedly the wearing of a 0.25 cylinder would often give relief to asthenopic symptoms. In these cases he thought the astigmatism was somewhere between 0.25 and 0.5. He was interested in the statement of Dr. Chisholm that version had in one instance been advanced from $\frac{20}{30}$ to $\frac{20}{20}$ by means of a 0.25 cylinder. He could not consider it as physically possible. There must have been some mental astigmatism.

MONOCULAR DIPLOPIA.

Read in the Section on Ophthalmology, at the Forty-second Annual Meeting of the American Medical Association, held at Washington, D. C., May, 1891.

BY I. H. THOMPSON, M.D.,
OF KANSAS CITY, MO.

The relation between the eye and brain has always been a fascinating subject for study, and as would be naturally expected, the school of ophthalmology has done very much to aid in the determination of the characters, symptoms and localization of cerebral troubles. The invention of the ophthalmoscope antedates but a short time the development of the cerebral surgeon, and although this instrument enables us to almost see the brain, it can only yet be considered an aid to diagnosis, for the knowledge we have of cerebral morphology is the result of the patient study of many minds and the sifted records of ten thousand cases. Every addition to the common fund of experience may be of value to all, so I feel that I am justified to introduce the subject diplopia monocularis, with a report of a case from my own practice, and review some cases from the writings of others. They are few and scattered, but they all refer to monocular diplopia dependent upon intercranial disturbances, and in no way the result of interocular disease or refractive error. My purpose in the preparation of this paper is to speculate on the cause of this remarkable symptom, and to try and find why it has been put down by certain chirurgical authorities as one of the signs of brain tumor. Whether monocular diplopia is a common occurrence or not, I am unable to say. My own experience is limited, but the fact that so little has been written about it by ophthalmic surgeons, leads me to believe that, as a symptom of nervous disease, it is rare or often overlooked. The following case is remarkable and of more than common interest:

Miss T., a healthy, moderately robust lady, 35 years old, was injured in a railroad accident on the 25th of July, 1890. She was sitting in a

chair car when the train, which was moving very rapidly, left the rails. The car turned half over and was thrown against an embankment. Although she was expecting to be hurt, and for that reason held fast to her chair, she was thrown completely down the car into the opposite corner. She was for the moment stunned, but rapidly recovered and, assisted by the porter, left the car. She received a slight cut over the left fronto-temporal region; she had no other wounds of the head, so after the bleeding stopped she walked around, attended to herself and conversed with the passengers. She took a relief train home, and went to bed. The next day she was sore from the bruises she had received, and found that she had a fracture of the coccyx. Because of the tenderness of the spine and sacrum she remained in bed four months; she was then able to sit up some little, and on several occasions went down town. On one of these trips she visited me. She complained of diplopia, which had lately come on, and which so annoyed her that she could not walk steadily or use the eyes at very close work, unless she bandaged one with a handkerchief.

I examined her eyes and found them slightly astigmatic. With each eye tested separately, and aided by the correcting cylinder, vision was normal; she had pronounced homonymous diplopia —the flame seen by the left eye was to the left and above the one seen by the right; the two flames could be brought on the vertical line by moving the candle to the right, but they could not be united without prisms. Pupil reaction normal, no color blindness. On pressure, the scar of the wound of the head was tender; no other symptom whatever of cerebral irritation. The diagnosis was simple myopic astigmatism ½ dioptre; paresis of the left external rectus and left inferior rectus, probably dependent upon injury of the head or spine. I saw her twice, and recorded no change in the condition.

In the meantime she entered suit against the railroad company for damages. I was summoned by her to testify, but refused to go into court as an expert without an extra examination.

At this examination I recorded monocular diplopia, and although I was suspicious, still, after a most careful trial with prisms, I was compelled to admit that she had not only homonymous diplopia, but also diplopia in each eye. When, in a darkened room, she looked at a lighted candle, she saw four distinct flames, and if a prism, base downwards, was moved before one eye, the moment the apex entered the pupil area she saw six flames. The same phenomenon was observed when the other eye was armed with a prism. In each eye tested separately she was double. In an endeavor to measure the paretic deviation, I was embarrassed by the inability of the patient to define the relative positions of the flames, which was further augmented by the fatigue the trial occasioned. There was a strong probability that the insufficiency of the left external rectus and superior rectus still existed in its original degree. Regarding the monocular diplopia I made the following note: Left eye examined, right covered, dark room, lighted candle at 20 feet, diplopia, flames diagonally opposite each other about 18 inches apart. Each light was equally distinct. A black dot on a piece of white paper, at reading distance, was seen double, diagonal diplopia; a black pencil 4 inches long, held vertical before the eye at 16 inches, was seen double, lateral displacement; held horizontal, double, horizontal displacement. When the pencil was tilted from the vertical to the right, the two objects approached, and at 45°—degree calculated as in fitting cylinders—the pencils were united, the patient described the picture as one pencil covering the other, the inner being nearest to her and projecting somewhat over the other. Beyond the diplopia and appreciable contraction of the visual field, the eye was normal, vision with cylinder —0.5 180° $\frac{20}{20}$. The right eye was examined in the same manner, the same diplopia, four lights, with the edge of the prism dividing the pupil; the same angle and relative distance of displacement. When this eye was examined with the pencil the same phenomena were observed as in the left, at exactly 45° the pencils united. When first tested, this eye had normal vision, but at the last examination vision had dropped to $\frac{20}{200}$, with the visual field very much contracted. Pupil reaction normal, no appreciable disease of the fundus. Suspecting that there may have been some organic lesion of the brain to account for such symptoms, I carefully sought for the different kinds of aphasia, word-blindness, etc., but could find no apparent disease whatever.

To my mind this was a case of hysteria, that the paresis of the recti muscles was of the character named by the French hystero-traumatique, and the monocular diplopia was the immediate result of autosuggestion. I so stated on the stand. Of course there is a possibility that the binocular diplopia first complained of referred in some way to functional derangement of the nerve centres. It certainly was not the result of nuclear paralysis, and a cortical lesion as the determining cause may with equal certainty be discarded. There are many reasons to believe that this symptom is in the majority of cases hysterical. To support my opinion, I beg leave to present a translation of a similar case reported by Brunschwig in the *Recueil d' Ophthalmologie*, August, 1889:

Leonie L., age 11 years, had for six years a converging squint of the right eye; had never had disease of the eyes. Suffered at 10 years of age from an attack of typhoid fever. We first saw the patient on the 3d of August, 1889, when we were asked to straighten the eyes. By oblique illumination and through a lens we could see that

there were two small nebulous deposits in the cornea, tending to a V-shape, but the ends were not united. The iris was normal, no ophthalmoscopic lesion. Both eyes were hypermetropic 3 dioptrics, also some astigmatism, but correction of the refraction did not very much improve the vision. Good perception of color by both eyes. The visual field is notably contracted, especially that of the right eye, whether tested by white or colored objects. An object viewed by the right eye is seen double; when a rod of red sealing-wax was held vertical before the eye at 1 metre distance, the patient saw two rods, lateral displacement about 5 centimetres and parallel. At 4 metres the objects were double and parallel, the two rods remaining about the same distance apart whatever distance they were away. If the rod was placed horizontal before the eye, it was seen double, vertical displacement, parallel and 5 centimetres distant. In whatever position the rod was held before the eye, it was seen double. The correction of the hypermetropia and the astigmatism had no effect on the diplopia, nor on the distance between the two images. A prism 10° placed horizontal before the right eye, the left being closed, gave a picture of four objects when the base divided the pupil area. The rod viewed with both eyes is seen triple, which lasts but a moment, for the squinting eye immediately returns to its false position. A stereoscopic examination did not in any way change the result, but when the patient viewed an object through a boise-de-Flees, it was found that the diplopia could be transferred to the left eye, if the patient believed the trial only referred to the vision of the right.

The author, in commenting upon this case, speaks decidedly in favor of an hysterical hypothesis, for, as he very properly remarks, what abnormal condition of the brain could bring about such a train of symptoms without other evidences of organic disease? Of course the last test and proof of simulation, made by the examination with the boise-de-Flees, was conclusive, and fixed decidedly the nervous nature of the complaint. In the light of our present knowledge of the hypnotic influence, we are prepared to believe that many more strange and remarkable perversions of the intellect are possible than have heretofore been supposed, and for convenience we place them all under the symptomatology of hysteria. We know that in certain mental conditions the phenomenon autosuggestion is easily excited, and is it not probable that its relation to the simple reflex movements is closer than neurologists are prepared to admit?

This may in a measure account for that peculiar symptom, monocular diplopia, which in the cases above referred to, was so prominent. In the child we had the squint, and therefore supposed diplopia, which was immediately referred or transferred to the right eye when, in an endeavor to measure the refraction of that eye, the attention was directed to the right visual field.

There are several circumstances which lead me to think that a like cause had a similar effect in my own case. The primary paretic squint and its necessary diplopia excited in a disturbed brain, an impression which culminated in a true visual hallucination.

I find several similar cases reported, two by Hayfelder in 1849. Both subjects were watchmakers; they recovered. Notice! That watchmakers learn to suppress the usual field of one eye; when working with a lens the near point is brought within the range of convergence.

Foutan, in 1885, reported to the Ophthalmological Congress the case of a boy 14 years old, a subject of monocular diplopia without ocular disease, but a true neurotic. Foutan, in commenting upon this case, suggests the following, which Brunschwig publishes, but questions: "The image formed on the macula is received normally by the nerve which divides at the chiasma, so that two similar impressions are conveyed to the corpora quadrigemina, or implanted on the visual centres at the cortex. Ordinarily the two pictures are united by a cerebral act or sympathy, which exists between the functions of the two brains. If, however, the joining of the two pictures does not immediately take place diplopia is the result." Should, because of functional disease or interference with the normal conduction of impulses or nerve discharges along certain established paths throughout and between the hemispheres, the personal equation of either brain be shortened or prolonged, there can arise a condition about the visual centre at the cortex analogous to paretic squint, or what the otologists call diplakousis. Therefore, I am inclined to the opinion that there is more in Foutan's theory than is commonly believed, and that in such cases the trouble lies in a lack of harmony between the two visual centres.

James E. Adams reported to the London Ophthalmological Society a case of monocular diplopia. A woman injured in a wreck, suffered from converging stabismus and monocular double vision which lasted several weeks. The trouble was referred to the right eye, in which there was no disease of the cornea or media. She received damages and then rapidly recovered; diagnosis, hysteria. Dr. Ord, *St. Thomas Hospital Reports*, 1879, case of boy 13 years old. An epileptic, could find nothing abnormal in the eye or brain.

In the opening paragraph of the report of a case of monocular diplopia, published by Sucamis in *Zahenders' Monatsblatter fur Augenheilkunde*, July, 1890, the author states that the diplopia has been recognized as one of the symptoms of

intercranial tumor. This is undoubtedly true, but after a careful perusal of the literature of brain lesions I am able to find but very few well authenticated examples, and they principally in recent publications. The most instructive case is one reported by Dr. Shaw, of St. Louis, in the *Kansas City Medical Record:* Chas. Green, a Scotchman, laborer, good family history, of sober habits; received a blow from a crowbar on the head eight years ago which rendered him unconscious for some time. He remained well until the summer of 1890, when he was attacked with vertigo and severe pain in the head. The headache became constant; he then developed symptoms of tumor of the brain, in staggering gait, vertigo, straddling walk, pain in the head, deafness of the left ear, right homonymous hemiopia and diplopia of the left eye, double optic neuritis, vomiting and epileptic attacks. The left ear began to discharge a short time before he was admitted to the hospital, but before that he had had a lump behind the ear which had been lanced twice. He never had earache. He died. The author, in reviewing the symptoms, had no doubt but that he had a case of brain tumor. The symptoms suggested either tumor or abscess; but the lack of fever, sweating, and evidence of inflaming before the ear discharged, rather excluded a probability of cerebral abscess and confirmed the opinions expressed. By an ingenious reasoning Shaw located a tumor in the cerebellum, immediately under the tentorium, probably pressing against the occipital lobe. Being anxious to complete the report of the case, I received of Dr. Dalton a copy of the Records of the City Hospital of St. Louis:

"Charlie Green was admitted to this institution Oct. 3, 1889, and died April 18, 1890. From him we learned that his family history was good so far as he knew. His father and mother died when he was quite young. He himself had never been seriously sick, but at one time or another he had all of his limbs broken. He was never addicted to drink. For some months before admission to the hospital, he had shooting pains in his head in the morning while lying down, but had no trouble when walking about. He has had, and has now an eruption on his hands, face, forehead, shoulder, and anterior portion of the thorax. It began on his chin, and had existed about one year. No history of syphilis could be made out. November 4, he informed us, for the first time, that he had received a blow on the top of his head eight years before; he was unconscious for awhile, after which he had no trouble. Four months before admission to the hospital he first noticed the present trouble. While working one day he suddenly became dizzy and remained so for ten or fifteen minutes; this was followed by terrible pain in the head, mostly at the base of the brain and about the occiput; pain remained several hours and then disappeared. The next day he had a similar attack; the attacks have been quite frequent since that time. The first sensation was a rush of blood to the head, then dizziness followed by severe pain, sometimes shooting in character, at other times dull. The attacks would usually last about two hours, and come on four or five times a week. He never became unconscious or delirious. During the last three months he has been very restless at night; talked a great deal in his sleep. His business had been that of a moulder, which he had to give up, because he was unable to stoop without causing a return of the headache. On October 10, a week after admission to the hospital, he was found standing in the watercloset in an unconscious condition, looking wildly around. He was gotten to bed with great difficulty, where he lay muttering and holding his hands to the side of his head. Pupils dilated; too restless to determine their reaction; heart active, though weak and irregular; face and lips pale. After a few hours returned to consciousness; stupid headache very severe; pulse weak; urine normal.

November 5. Patient complains of the pain in the head, especially at the base of the brain; this condition now remains almost constant. Attempts to wander around the wards in an aimless manner, with difficulty kept in bed. Was given large doses of the iodide of potash, without benefit. On January 6 a few epileptic attacks were noted, and these were preceded and followed by severe headache, which would always begin in the posterior and lower portion of the head, and soon pass over the entire skull. This was accompanied by dizziness. He always fell on his left side, and in walking during these attacks he always walked to the left. Hearing in the left ear defective, left eye amblyopic. He sees double with this eye always, sometimes also with the right eye. He has right hemianopsia, sometimes the entire field is narrowed. On the 2d of March he had a severe fit, followed by intense headache; this condition continued about the same until April 8, when he died in a convulsion.

The post-mortem examination showed all the organs normal except the brain. On opening the calvarium a large quautity of cerebro-spinal fluid escaped. In the right lobe of the cerebellum was found a cyst holding perhaps half an ounce of fluid, and a tumor about the size of a small lemon. The growth extended up into the right peduncle."

Another very interesting and well prepared case is reported by Dr. Tilley, of Chicago, in the *American Journal of Ophthalmology*, January, 1888:

"Mary R., 9 years old, orphan, was presented to Dr. Tilley suffering from a peculiar train of symptoms. Her face had the appearance of her

being in great distress, and she held her head as if she was afraid of jarring it; spasmodic ptosis; she complained of some infra-orbital pain, which was increased by pressure; she also had pain on lateral movements of the eyes, so that she moved the head in looking sideways. There was no paralysis or paresis of any of the muscles. She suffered from headache which came on every day. No malaria. Conjunctiva slightly congested, lids, cornea, lens, vitreous and retina normal. Vision $\frac{6}{18}$, pupils normal and reaction normal. She complained of double vision in the left eye. A probe held vertical before her was seen double, horizontal displacement; held horizontal, double, vertical displacement. A most careful examination to detect fraud, convinced the doctor that her statements were true. At all parts of the visual field diplopia was present, the distance between the two images corresponded with the distance the object was from the eye. The sign of the interocular angle increased as the visual line was lengthened—at 1 metre the displacement at the retina was .074 millimetre, at 6 metres about .456 millimetre. Paralysis of the accommodation by atropia made little difference in the subjective phenomena, but the secondary image appeared nearer. The patient was completely red-blind. These observations were made during November and December, 1887. On the 13th of December, the girl had symptoms of cerebral disease; vomiting, delirium, etc. The child improved. Dr. Tilley visited his case in January, 1888, and found her suffering from abscesses all over the body, which inclined him to believe that at one time there had been an abscess of the cerebrum encroaching upon the lateral ventricle."

John Abercrombie, in 1881, reported a case of a girl suffering from headache, vomiting, peculiarities of speech, paralysis of the right side, with paralysis of the right external rectus. She had double monocular diplopia. On post-mortem examination, found a large abscess in the left occipital lobe and rupture into the ventricle.

The three above cases are well-marked examples of diplopia monocularis dependent upon intercranial disease. In Abercrombie's case we find an abscess of the right occipito-temporal lobe. Of course the extensive disease of the brain substance and membranes, together with the ventricular empyema, was undoubtedly the cause of death, but this was the sequence of an inflammation starting in the occipital lobe which affected (not involved) the right cuneus and optic tract, by pressure or irritation. Although it is extremely difficult to determine the relation between cause and effect, the paralysis of the external rectus depended upon an inflammation at the base involving the sixth nerve in its course, and not nuclear. It may be asked, if this reasoning is correct, why was there now left homonymous hemiopia? I think the seat of the abscess was too far from the cuneus to immediately destroy that visual centre, but sufficiently near to embarrass it. In the Tilley case, the author was inclined to locate the trouble near the third ventricle, but he candidly admits his inability to explain the sequence from cause to effect. The symptoms were unquestionably cerebral, and probably the cause was an abscess deep in the substance of the left occipital lobe.

The Shaw case is both interesting and instructive. The diplopia monocularis was one of the principal symptoms. That there was direct pressure and disturbance of the visual centres is demonstrated by the post-mortem. A tumor of the right cerebellum, of the character and size found in the autopsy, could hardly exist without distending the tentorium and pushing aside the posterior convolutions of the occipital lobes. Although I can understand the sequence of symptoms in this case, I can hardly explain the right hemiopia unless there is a mistake in terms. The choked discs could account for the narrowing of the visual fields, but not the hemiopia. It is evident, therefore, that the lesion was at the visual centres, and inasmuch as the diplopia could not have been recognized if the object was focused on the blind area of the retina, the irritation or cause of the phenomenon must have been at the visual centre least affected by the disease, viz.: the left cuneus. I have grave doubts if the so-called papili can occur unless there is some obstruction about the venous sinuses. Putting aside Seber's theory of the inflammation of the nerve caused by the presence in the vaginal sheath of irritating material, it is hard to explain the hypertrusion of the arachnoid fluids without admitting the probability of venous obstruction. Therefore, I am led to think that a lumen in the cerebellum large enough to interfere with the return of blood through the lateral sinuses, could very well paralyze by pressure the terminal occipital convolution, and involve the cuneus. This may explain the relative rareness of monocular diplopia. Hemiopia from tumor or abscess in the occipital lobes is common, associated with choked disc and amblyopia, when the diplopic symptom, which under different circumstances would be apparent, is marked. I think that monocular diplopia more often exists, but is overlooked. In nearly all, at least the majority, of the cases reported, this symptom was seen in connection with paralysis of the sixth nerve, a peculiar and remarkable coincidence. It is hardly reasonable to suppose that an individual suffering from extensive tumor or abscess of the brain would be in a condition to notice a visual peculiarity of this kind, unless by chance the attention was stimulated by an extraordinary examination. The history of the cases at our disposal, those reported by Shaw, Tilley, Abercrombie and others, is an evidence that double vision, confined to

one eye, is not so rare as has heretofore been supposed. My conclusions are:

1. Diplopia monocularis is, in the majority of cases, one of the symptoms of hysteria, provided there are no physical conditions in the eye which can cause an object to be focused on two spots of the retina at the same time.

2. Diplopia monocularis in connection with recent or old squint, paralytic, hysterical or otherwise, is a symptom of a psychical condition, closely related to hysteria, in which the phenomenon, autosuggestion, is easily excited.

3. Diplopia monocularis not dependent upon disease or abnormality in the eye, but in connection with other symptoms of intercranial trouble, especially choked disc, hemiopia, paralysis, particularly when the train of symptoms points to tumor or abscess, is strong evidence that the lesion is situated in or about the posterior convolution of the occipital lobes.

AN EXAMINATION OF VON GRAEFE'S DOCTRINE OF "ANTIPATHY TO SINGLE VISION."

Read in the Section of Ophthalmology, at the Forty-second Annual Meeting of the American Medical Association, held at Washington, D. C., May, 1891.

BY GEORGE T. STEVENS, M.D.,
OF NEW YORK.

In Von Graefe's classical description of the condition to which he applies the term "Antipathy to Single Vision," he says: "It has sometimes happened to me that after squint operations with apparently correctly adjusted visual axes there have resulted double images only slightly removed from each other. The visual power of each eye has been quite good, alternating strabismus having previously existed, and the accommodative power has been similar in the two eyes. Nevertheless it has been in no way possible to bring about single vision."

He states that this condition of double seeing persists notwithstanding the interposition of prisms in various positions, and that every effort of the patient to unite the images results only in removing them to still greater distances.

He adds: "The tendency appears to be a direct physiological contradiction; for while in sound eyes some approach, especially in case of large retinal pictures, is sufficient to induce arbitrary muscular contraction in the interest of single vision, in these cases, on the other hand, it is found that exactly the opposite condition prevails, there being an absolute incompatibility to single vision." [1]

In a still later article [2] he describes the condition more at length, pointing out the fact that the double images, although not far removed, pass from one side to the other, above and below, or one behind the other, always on the point of uniting, but never united. Von Graefe explains the anomaly on the theory, first, of injury to the nervous centres of faulty projection from the retinæ, and, second, of the supposed difficulty of obtaining regular associated action between muscles which have long been unaccustomed to association.

A careful examination of many of these cases of "antipathy to single vision" leads me to conclusions different from those arrived at by Von Graefe, and the practical application of these conclusions has shown that they are, at least in a great measure, correct. That, in a proportion of these cases, the technical details of disturbing elements may elude our search is undoubtedly true, but that the principles which I shall present will apply very generally I am fully convinced.

In a paper read before the American Medical Association, June, 1889,[3] I have already expressed my disbelief in the generally accepted view of the existence of a physiological antipathy to single vision, and my conviction that, by properly selected and properly executed proceedings, this unpleasant condition may usually be eliminated.

The view of the causation of this anomaly, as set forth in that paper, may be briefly condensed into a single sentence.

The condition of antipathy to single vision as described by Graefe and by subsequent authors depends not upon lesion of the brain or faulty projection of the images from the retinæ, but upon unequal tension of corresponding ocular muscles under the influence of corresponding nerve impulses directed to them.

I do not assert that no irregularity in projection from the retinæ can occur, nor that cerebral lesions may not induce incorrigible diplopia. Such cases, if found, will present other and more definite phenomena of the existing ocular or central nervous disease than simply the presence of diplopia. The proposition refers to the cases which come fairly within the class so clearly described and so sharply defined by Graefe.

Excluding then, cases of paresis, and confining ourselves to the class of cases thus defined, we shall find the causation of this supposed antipathy mainly in two conditions. The first of these is acquired as the result of the squint operation or operations. It consists in the fact that by unequal settings back of the insertion of the corresponding tendons, there are induced irregular responses to the impulses directed to these corresponding muscles. In the examination of a very large number of cases, I have found this condition, but generally modified by a second to be mentioned presently, by far the most preva-

[1] Arch. für Ophthalmologie, i, 1, 118.
[2] Arch. für Ophthalmologie. iii., 1, 119.
[3] Published in Archives of Ophthalmology, vol. xviii., p. 371.

lent. There will be found in such cases either an excessive rotating power, or a power of rotation only moderately restricted, of the muscle of one eye, internal or external rectus, while the rotating power of its direct associate of the other eye is materially restricted. As a consequence of this irregular and unequally balanced condition of opposing muscles no harmonious adjustments can be made, and the more earnestly the patient strives to bring about associated action, the more signally he fails.

That "settings back" of the ocular muscles to an unequal extent may be made with propriety and with success, was taught by the great master, Von Graefe, himself, and the practice has been very generally continued to the present time.

It is true that Von Graefe advised in extreme cases a division of the operation between the two eyes, but in fact, this was a concession only to most obvious disabilities involved in the failure of the most conspicuously associated movements toward the side opposite the eye operated on, if in a case of converging strabismus, and an impediment to even approximate convergence at near points. Within the limits of extreme results a full correction of the appearance of squint was, according to his teaching, not only permissible but desirable. This proceeding of making a correction of squint by a single operation has been supposed to be sustained by the theory that the muscle of the squinting eye is pathologically shortened to a considerably greater extent than its antagonist.

It may be conceded that there is, within certain limits of unequal tensions of accordant muscles, a possibility of union of images; otherwise binocular vision would in no case be established except when exact balancing of the tension is secured. That easy and permanent associated action is compatible with any considerable degree of diversity of tension, I do not believe.

It may be objected that if this proposition is correct the proportion of perfect corrections for squint by the prevailing methods of operating must be less than is ordinarily supposed. It is probable that examinations made by methods more exact than those which have been ordinarily employed would show that a very large proportion of cases in which binocular vision has been presumed to have been established by the ordinary squint operation is much smaller than is commonly supposed. However this may be, whether the results of the standard squint operation is often successful or not, it is certain that such unequal tensions are in many instances incompatible with a blending of the images.

A second causative influence, and one which acts as an element in nearly all of these cases, is the difference in relative tension of muscles which act in the vertical direction.

The instinct of bringing images to the same horizontal plane appears to be very great and only second, if indeed it is second, to that of union of images. In case of double images, whatever the difficulty of blending may be, the patient instinctively exerts his best endeavors to place the images in the same horizontal plane. It thus happens, that in certain cases in which, either with or without slight lateral inequality of tension, the effort to bring images to the same plane induces a lateral squint,—a squint which may be variable; that is, such a squint may at one period of life be converging, and at another diverging. Thus, in a case now under my observation, the patient was, during her childhood, subject to a very pronounced converging squint. During the past twenty years she has had conspicuous diverging squint, although no operation has been made. Such a condition may properly be called *variable strabismus*, its character of divergence or convergence changing from time to time, remaining possibly in one direction during several years, then changing to the opposite direction.

FIGURE 1.

If in such a case one or both interni or externi are cut, double vision of an intractable form is likely to result. In such cases we must make diligent search for the vertical deviation, a condition often obscure or not at all manifest, before we can succeed in establishing binocular vision.

I have had the good fortune to obtain a daguerreotype portrait of the lady whose case has just been mentioned, taken during her childhood, and from which I have made an enlarged photograph which I have the pleasure of show-

ing (Fig. 1). The photograph shows converging squint, so pronounced that few ophthalmic surgeons even at the present day would hesitate in regarding it as a proper case for a free division of the internus of one, if not of both eyes. Had such an operation been performed upon this patient in early life, intractable diplopia would doubtless have resulted, and eventually extreme diverging strabismus. In another photographic portrait of this lady, made by myself a year ago (Fig. 2), a moderate appearance of diverg-

FIGURE 2.

ing strabismus is seen. In fact a divergence of more than 12° with corresponding crossed diplopia existed. But the most striking feature suggested by this photograph is the left hypertropia, well defined in the position of the eyes and of the brows. The question at once arises whether the change from converging to diverging strabismus is not the result of some radical change in the static condition of the eye-muscles. That this is not the case will be seen by the most cursory glance at the third portrait (Fig. 3), in which the old converging squint has returned. This condition of convergence can be induced at

FIGURE 3.

any time by the application of a solution of atropine to the eyes. At the time of taking this third portrait, atropine had been applied twice a day for three successive days, and its effects were complete. A week after that time the diverging squint had returned and has continued during the year. The transformation from divergence to convergence occurs within an hour after the first application of the atropine, and the present habitual condition of divergence returns as soon as the effect of the drug passes off. This variableness is, without doubt, due to the action of the muscles in the effort to overcome the unequal height of the images, and until the condition of the hypertropia is eliminated such changes of the lateral relations are liable to occur. In passing, a single thought may be given to the adverse testimony of such cases to the well-known doctrine of the relations between the excessive efforts at accommodation and converging strabismus; for here the converging strabismus occurs only when accommodation is neutralized. The present interest in the case centres in the fact that had a free tenotomy of an internus been practiced during childhood, the almost certain result would have been an "antipathy to single vision." Even at the present time, when the conditions of hyperphoria and hypertropia are carefully sought for, this patient is able, under many circumstances, to conceal completely the evidence of hyperphoria as shown by the phorometer.

FIGURE 4.

A curious fact in connection with the inequality of tension of the lateral muscles associated with hyperphoria is, that a condition which in a passive state of the muscles of either eye or of both eyes is a marked divergence, becomes, as soon as all the muscles are engaged in the act of adjustment, pronounced convergence attended by homonymous diplopia. Conversely a like change may occur when the tendency is, in the passive state, to converge.

A very practical illustration of what has been stated may be found in an actual history which I condense for this purpose. In a child with left hyperphoria (or hypertropia) the left eye drifted outward during the first few years of life. (Such a diverging squint is rarely observed by parents unless it is extreme.) At length, presumably as the result of a change in the methods of making the efforts to adjust for the horizontal plane, the squint became convergent. The ap-

pearance of the eyes of this patient in early childhood is represented in Fig. 4, which is copied and enlarged from a daguerreotype picture of him taken at the age of about three years.

About three or four years later, and after the divergence had given place to convergence, a surgeon performed tenotomies of the two recti interni, presumably severing both tendons completely. The result proving an over-correction, the effect of the operation on one eye was modified by the insertion of a (conjunctival?) suture. The result, in view of what has been stated above, was such as we might anticipate. Double vision of the most annoying character was always present. The efforts of many distinguished surgeons to induce these twin images to unite by means of prisms, even for an instant, were fruitless after trials repeated during many years. The case found a prominent place in ophthalmological literature, endorsed by several distinguished surgeons, as one of the class now under discussion. No case could therefore afford us a better model for our study.

It proved easier for this patient to fix objects with the left eye. That being the case, we may suppose that he would make a certain effort of adjustment with the weakened internus of that eye, which would be associated with a corresponding excessive effort of the opposite internus. But these unequal efforts would also be combined with the effort to adjust for the difference in the positions of the images with reference to the horizontal plane. The result would be an excessive rotation of the right eye to the nasal side with homonymous double images. If, on the other hand, a patient with this combination of defects should look at an object which is isolated from other objects which may serve to aid the disabled eye in active adjustment, as, for instance, at a church spire, or at the moon, or a bright star, in which cases only the clear sky is in immediate relation to the object, the most disabled eye would at once drift outward, and crossed diplopia would result. So also, if a small screen were to be interposed between either eye and the object looked at, thus shutting it out from active participation in the effort of adjustment, the covered eye would diverge in a marked manner and would move inward, perhaps to the extent of one third the diameter of the cornea, as soon as the screen should be removed, and then homonymous diplopia would be observed. Or again, if the subject of such a defect were to look through a grating, as, for instance, through the palings of a picket fence, an object seen beyond the fence would be seen doubled, and the diplopia would be crossed; while an object seen between the person and the fence would be double also, but the double images would be homonymous. In the first instance, looking beyond the fence, the adjusting energy of one eye becomes passive, as in the case of looking at the object against the clear sky, with resulting crossed diplopia. In the other instance, looking at the object nearer than the fence, active adjustment of both eyes occurs with excessive convergence and homonymous double images. All these suppositions and conclusions have been fully justified in the actual treatment of these cases.

In certain cases in which this intractable diplopia exists, the patient has the extraordinary faculty of selecting at will which eye shall fix the object, and the diplopia becomes homonymous or crossed, according as the one or the other eye is engaged in direct fixation. Thus, in the case of a lady patient, if I direct her to look with the right eye, I can see that the eyes are strongly converged, and she reports the presence of homonymous double images. If I then direct her to look with the left eye, the change may require a few seconds or it may take place very quickly. Then the eyes are plainly seen to diverge, and the diplopia is crossed. In such a case, the nervous impulse directed to the right internus is greater than the normal during fixation with that eye, and when a corresponding impulse is sent to the left internus, the eye is caused to swing in excessively and too great convergence results. On the contrary, when the left eye is fixed, there is no such excess of nervous impulse sent to the left internus, and as no excessive impulse is therefore sent to the right internus, that eye swings outward passively, and crossing of images results. But in this explanation we must lose sight of the important, probably the most important, element in the causation of the inward swing in many if not in the majority of cases. This is the influence of the difference of tension of the muscles which move the eyes in the vertical direction. This influence is often sufficient, even though the moving power of the corresponding lateral muscles should be equal, to cause a swing beyond that which would result from a given impulse to a lateral muscle. I have rarely met with a case of the so-called "antipathy to single vision" in which this element did not play an important rôle.

It needs no argument to show that the defect which causes the patient to have homonymous diplopia when looking at an object, say at twenty feet distance, and heteronymous diplopia when looking at the same object, if a grating, like the fence of which we have spoken, is interposed between the eyes and the object, or which causes the same patient to have homonymous images when looking at an object surrounded by other objects, and crossed images when looking at an object isolated from visible surroundings, lies neither in the brain nor in faulty projection from the retinæ, but in peculiar, although perhaps obscure, defects in the adjusting apparatus.

Homonymous diplopia caused by a brain de-

fect or a retinal defect would remain homonymous under all the circumstances which have just been mentioned. Activity or passivity of certain efforts of adjustment could and would be modified by the circumstances mentioned, and the phenomena resulting, which at first appear confused and irregular, are in reality uniform and in accordance with fixed laws.

It is not to be denied that the investigation of an individual case is often surrounded by immense difficulties, or that each new case may present new and perhaps at first incomprehensible phenomena. It is none the less true that all these cases will be found to be governed by known laws. If the difficulties of interpretation of the phenomena in individual cases are great, it demands the greater skill and patience on the part of the investigator in searching out all the various influences which combine to make the defect.

It would probably be impossible, even if all the facts were in our possession, to lay down distinct rules for the discovery of the exact nature of the faulty relations of muscular tension in each case of this class. To attempt it even to the extent to which the principle has been studied, would be to record separately the experience in each individual case. Enough has been said, however, to indicate the lines on which the investigation is to be made.

In the correction of the defect—this incompatibility to single seeing—we must logically seek to reëstablish a degree of equilibrium between the mobilizing functions of the opposing muscles. To this end, after first correcting the unequal tendency in the vertical direction, it will, in most instances, be necessary to bring the insertion of the disabled muscle forward, and to reduce the tension of the corresponding one of the other eye. This procedure is by no means as easy as might appear. To readjust the tendon after such a setting back as occurs in the standard squint operation, requires in many instances the most persistent and skilful treatment.

Very little can be accomplished by a gross advancement, in which the already disabled muscle is made even less flexible than before. The object is secured by progressive steps, one slight advancement preparing the way for another, until the proper degree of rotation, with as great flexibility of the muscle as possible, is secured. Then the corresponding muscle of the other eye, if it has not been already relaxed, must be made to assume, as nearly as is required, a corresponding adjustment, by a careful relaxation.

Such a procedure has, in my hands, succeeded in establishing binocular vision in many inveterate cases of the so-called "antipathy to single vision." The process is often long and difficult, making the greatest possible demands upon the skill, courage and patience of the surgeon, and the persistent and intelligent coöperation of the patient.

It has been my purpose to do no more than to indicate in a very general way the principle which I would advance, namely: that incompatibility to single seeing usually denotes incorrect methods of operating, and that there can be no effectual correction of strabismus which leaves the tension of the corresponding muscles of the two eyes unequal. The supposed success of many cases in which such inequality is caused by operation, doubtless results from the fact that in the remaining diplopia the images are so widely separated that the patient does not become aware of its existence.

In order to avoid the evil results of diplopia, and to secure not only possible but easy binocular vision, then, we must be guided, first, by the actual rotations of the eyes, and by the actual relations of the visual lines, not only in the lateral but in the vertical direction. This can be accomplished only when the patient recognizes the position of double pictures, and this according to the theory of identity. There should be no final operation for the adjustment of squinting eyes, until both patient and surgeon are sure of the relative position of the double images.

A precept which I have elsewhere brought forward is in this connection also of essential importance, viz.:

"*Every modification of the length of a lateral muscle, by relaxation or by shortening, which can in any degree affect the rotation of one eye, should in eveey instance be accompanied by an exactly equivalent modification of the corresponding muscle of the other eye.*"[4]

If this precept is correct, the practice of relaxing or setting back of an internus, accompanied by an advancement or shortening of the externus of the same eye, while the muscles of the other eye undergo no modification, cannot afford the best results.

The subject of the determination of the relative tensions of the various eye muscles I have already discussed at some length, in a series of articles published in the *Archives of Ophthalmology* during the years 1887, 1888 and 1889. It is unnecessary to repeat what has there been said, but there is also much more which might be said in connection with the examination of the relative tensions in these peculiar and most difficult cases, which must be reserved for another occasion.

One point, however, is so important in its relation to the subject under consideration, that it should not be separated from it. This is the examination of the comparative rotation of the two eyes in the temporal and in the nasal direction. Something can be learned from an inspection of the movements of the eyes as the surgeon causes

[4] Anomalies of the Ocular Muscles, Arch. of Ophthalmology, 1889, p. 407.

the patient to follow with the eyes a pencil or other object as it is carried from side to side, the patient making his best efforts to see it as far toward the extreme outer field of vision at each side as possible. It will in most of the cases, in which the original operation has been performed for converging strabismus, be seen that as the eye on which the operation, or the most extensive operation, has been performed, moves toward the nasal side, its progress is arrested before the border of the cornea reaches the inner canthus.

The nasal rotation of the other eye will often be found to be free, or even excessive. But even the nasal rotation of this other eye may be restricted, only in less degree than the first. Similarly, we may observe a difference in the temporal rotation. This method of inspection, while important and in some measure satisfactory, furnishes less exact information than is required in most cases.

In the measurement of the temporal rotation, we have in the perimeter an instrument of sufficient precision. It is my custom to place in the carrier of the perimeter a few capital letters in clear type, of about the size 2 = D. of the Snellen scale, and require the patient to see the letters with sufficient clearness to read them. A glass to meet the requirements of the patient's vision is held in such a way before the eyes, that it is at a right angle to the line between the eye and the test object. Ordinarily, a pair of eyes in which no considerable degree of heterophoria exists will make the temporal rotation about 40° each, and no considerable difference in this rotation should exist. In many of the cases under discussion, the temporal rotation will be found to differ for the two eyes to the extent of from 10 to 20°. With the new model of the registering perimeter, this element can be quickly and accurately determined.

Unfortunately, we have no method so accurate for examining the nasal rotation. The full rotation of the eye in this direction in the normal condition cannot usually be determined by the perimeter, except by the supplementary use of a strong prism. Even with this supplement, the extreme rotation inward of cases of slight converging squint cannot be registered by the instrument. In cases in which the rotation does not much exceed the line of vision across the bridge of the nose, we may place a rounded prism with its apex in the canthus. Two degrees of prism equal one degree of the perimeter. Hence a prism of 10°, apex in the canthus, may cause the eye to turn inward 5° more than it would in looking directly at the object. The expedient of placing a scale of degrees on the lower lid, and reading from it the nasal rotation, while inaccurate, is sometimes the only recourse, and the best use of an unsatisfactory method must be made.

DISCUSSION.

DR. J. H. THOMPSON said that he had found the operation for squint a very difficult one to gauge. He does not now believe it is so often due to hyperopia as Donders taught, often seeing it in emmetropia. Believes it to be due in many cases to congenital amblyopia. He thinks that after a squint operation with good vision in both eyes, if there is antipathy to single vision, the trouble is in the brain. When a muscle is set back, it often does not symmetrically reattach to the globe, and a want of coördinate action leads to divergent squint. He believes in cutting very little, and in advancing the weak muscle.

DR. EDWARD JACKSON had seen three cases falling under Dr. Stevens' classes. He thought in these cases there was some anatomical defect in the nerve centres, the squint dating from infancy, and there never having been fusion of images. In one case there was anisometropia and would fix differently with the two eyes, possibly lying in a defect in the commissures.

DR. STEVENS, in closing the discussion, called attention to the want of equality in height between the two eyes, one being generally on a different level from the other. He finds this in all cases where there is no other palpable cause. On correcting this difference in level, the adjustments become more and more perfect.

HÆMORRHAGIC GLAUCOMA WITH AN ANALYSIS OF THREE CASES.

Read in the Section of Ophthalmology, at the Forty-second Annual Meeting of the American Medical Association, held at Washington, D. C., May, 1891.

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By hæmorrhagic glaucoma I understand that form of glaucomo which is preceeded by numerous hæmorrhages in the retina, and when in the majority of cases the glaucomatous symptoms do not show themselves for many weeks after the visible retinæ changes. It is hence a secondary glaucoma. The youngest case on record occurred at 35 years of age and is reported by V. Græfe. The disease occurs most frequently in persons who have passed the fiftieth year, and there is every reason to believe that the time of life is here an essential factor. The attacks generally commence with a sensation of pricking beneath the lids, as though a foreign body were lodged there. The lachrymation is considerable and there is much conjunctival injection. The pains radiate all around the eyeball, down the side of the nose and over the head frequently back to the occiput. We have, in other words, a most aggravated form of ciliary neuralgia.

In these features the disease does not differ from acute inflammatory glaucoma, though in my opinion, the attacks last longer, and even between the paroxysms—which by the way, come on oftener toward night—the patient is rarely free from pain.

There are then no complete intermissions. Before the glaucomatous symptoms fully manifest themselves there is no appreciable increase in tension, and often at the beginning of the attack it is generally impossible to get a view of the fundus on account of the cloudiness of the media. So one cannot speak positively as regards the arterial pulse or optic nerve excavation. In the one case where I had an opportunity of making sections of the nerve no excavation was present. According to Paymstecher, these two latter symptoms are not met with in this variety of the disease.

As regards the frequency of hæmorrhagic glaucoma, fortunately the disease is of comparatively rare occurrence.

In eight years, von Graefe[1] observed in his enormous practice 22 cases. Laquer[2] in 268 cases of glaucoma met with about three per cent. of the hæmorrhagic variety.

As a general thing the patients affected were hypermetropic, although the disease has been known to occur in an emmatropic individual. Hæmorrhagic glaucoma, as far as I know, has never been seen in connection with myopia; arterio sclerosis is commonly seen in this class of patients, and this no doubt explains why a not inconsiderable number die sudden deaths.

The disturbances in vision, while sudden and rapidly increasing, do not assume the typical characteristics of primary glaucoma; in other words, there is no narrowing of the visual field on the nasal side. Chromatopsia and photopsia can both be present, but as a general thing they are lacking.

The hæmorrhages which one sees do not appear to be located preferably near the blood vessels, but are to be found mostly in the vicinity of the posterior pole of the eye, the papilla and macula, in a word everywhere, over the fundus.

The hæmorrhages have generally a ragged irregular outline; seldom are they perfectly round. In addition to smaller spots of relatively lighter red, there are to be seen larger hæmorrhages of a more intense hue, which sometimes break through into the vitreous and give rise to extensive opacities of the latter. The retinal veins are tortuous and distended, just what we see in hæmorrhagic retinitis, while the arteries fail to show any increase in size.

The process can remain at this point for a considerable length of time, indeed remissions can occur now and then, until from time to time new or more extensive hæmorrhages take place. The older hæmorrhages may undergo degeneration (fatty), and assume the white appearance seen in albumenuric retinitis, though the singular grouping of the white plaques as is seen in the latter disease is here absent.

After light perception has gone, and the glaucomatous attacks cease, there occurs not infrequently a detachment of the retina and coincident with this condition, a lowering of intra-ocular tension. Such has been the history of the first case reported in this paper. The eye tension is here below normal, and I am inclined to think that the eye will always remain just in this condition. In other cases we meet with glaucomatous degeneration of the eyeball terminating in either phthisis bulbi or in staphyloma of the cornea or of the sclera.

When one looks into the literature of his subject with reference to the value of iridectomy one meets with rather disheartening revelations. Graefe operated in six cases and with bad result in every case, and hence he advises against[3] iridectomy. In several cases immediately after the operation there followed numerous hæmorrhages in the retina. Sometimes the operation had the effect of assuming intra-ocular tension, but the benefit was only a temporary one. Paymstecher and Horner both seemed to have practically failed to get permanent relief through iridectomy.

On the other hand Coccuis,[4] Becker,[5] and Laquer[6], each report a case where the operation was followed by permanent benefit. General experience, though, seems to verify the fact that iridectomy is not apt to be followed by the same good results which one sees when the operation is performed for a primary form of glaucoma, and the reason of this is to be sought for in the fact that the changes in the choroid and retina are so extensive, so vital at the time that iridectomy is indicated, that the blood vessel walls cannot stand the changed condition of the circulation immediately following the operation and the effect of the latter is frequently to precipitate fresh hæmorrhage and to elevate intra-ocular tension.

Each of the three cases reported here presents the typical history of hæmorrhagic glaucoma. And in the response to the several kinds of treatment resorted to, each case brought out much that was interesting and instructive.

Case 1.—Mrs. P., 52 years old. Has for several years been subject to violent attacks of sciatica of the right leg. She has otherwise enjoyed good health, and furthermore, has never complained of her eyes. One evening before retiring she had occasion to close her right eye and im-

[1] Handbuch du gesammt. Augenheilk. Graefe u. Saennisch, p. 185.

[2] Annal d'ocul. LXI. p. 55.

[3] Archiv fur Ophth. xv. 3, p. 192.

[4] Archiv. fur Ophth. ix. p. 8-10.

[5] Klinische Monatsblatter 7, 1869, p. 397.

[6] Annal d'ocul. lxi. p. 56.

mediately she found that everything in the room appeared as though enveloped in a cloud. She could no longer define the outlines of objects. On getting up the next morning she could not, with her left eye, recognize a person across the room. Her family physician, whom she forthwith consulted, assured her that she was suffering with an attack of indigestion and he treated her accordingly. Not getting better, she came to my office three days after she first noticed the disturbance in her vision, April 29th. R. E. V. $\bigcirc \frac{20}{15}$ with + 1.25 D. s. I. E.V. = counts fingers in 6 ft.

The ophthalmoscope revealed numerous small hæmorrhages around the disc and in the region of the macula. Several small white plaques were to be seen near the papilla. There was no optic neuritis, though the blood vessels were dilated, and at several points not remote from the optic nerve they gave evidence of minute ruptures having occurred. Tension of the eye at this time was normal. I made a diagnosis of hæmorrhagic retinitis; a thorough physical examination was made but with negative result. The urine revealed nothing abnormal. I put her on Iod. Potas. 10 grs. three times daily, gave her smoked glasses and forbade her using her eyes. At the end of six weeks neither the objective nor the subjective symptoms had changed. About this time she went north to spend the summer, and a few days later she wrote she thought she could see somewhat better. About six weeks after she arrived she had a violent attack of sciatica and suffered intensely for many hours. No sooner had this attack subsided than she began to suffer torture with her eye. Boring, lancinating pains over that side of the face and particularly severe down the side of the nose. Her daughter wrote a most accurate account of her symptoms and I advised her to consult an oculist immediately, as I suspected glaucoma. She consulted Dr. A. Adams, of Newburgh, N. Y., and it is to his courtesy that I owe the following account of her condition. "In the afflicted eye" he writes, "I find T. + 2, pupil widely dilated and no reaction to light, slight chemosis. Ophthalmaoscope showed retinal hæmorrhages, mostly old ones, but there was certainly one fresh hæmorrhage and about the size of the papilla and situated between the latter and the macula. Vitreous a little hazy. R. E. V. = $\frac{20}{20}$. L. E. V. counts fingers in 10 inches.

Dr. Adams treated her for several days with antipyrin and eserine, and she got so much better that she determined to return home. The day after reaching home she had an attack, and I was sent for. I found her suffering intensely. The tension of the eyeball was at its maximum and the media were all closed, showing the general disturbance in the nutrition of the eye. Anterior chamber shallow, and scarcely more than light perception was present.

Dry heat (in the form known as Japan Box), and eserine 2 gr.—ozj, instilled every four hours, gave her comfort for two days, when the pains returned with more violence than ever. I then determined to perform iridectomy, which latter was accomplished without accident. Relief was immediate and complete, and lasted for three weeks, after which time the pains returned, and I concluded to resort to paracentesis of the vitreous. This operation was performed with the patient sitting in her chair. I passed in a Graefe cataract knife one-fourth of its length into three points of the eyeball—above, just at the posterior and temporal side of the insertion of the superior rectus, and in the equatorial region at the nasal and temporal side. This was on the 7th of November, since which time she has been absolutely free from pain. There have been occasions when the tension has mounted up, but never a moment of suffering. The pupil is now widely dilated, and the eye is somewhat more compressible than its fellow. Light perception has gone. The retina is detached, and there are numerous striations in the lens. One rather unusual thing occurred in connection with the use of eserine in this case. A violent conjunctivitis followed its constant use several times daily, the lids became swollen and there was present the most profuse lachrymation. These symptoms, which are those of what I should call *eserine conjunctivitis*, disappeared entirely when I stopped using the drug. The disease no doubt resembles in its history what is known as atropine conjunctivitis. I have never seen any mention made in the books of this effect of eserine.

The second case is that of a woman 44 years old, who two days before labor noticed that she saw very indistinctly with her right eye. The labor was a protracted one, and when she got out of bed only light perception remained in that eye. When she consulted me, I found nothing noteworthy about the external appearance of the eye. The ophthalmoscope revealed hæmorrhages covering almost the entire fundus. Vitreous hazy.

There was hyperopic astigmatism against rule in her good eye of $\frac{1}{2}$ dioptre, and with a correcting lens she read $\frac{20}{15}$. A physical examination failed to reveal any constitutional disorder.

I told her that nothing could be done, and so put her simply on tonic treatment. Two months later she returned to me, suffering with an attack of glaucoma; the pupil dilated, conjunctiva injected, and T. + 2. I used eserine with no effect whatever. She urged me to take the eye out, but I persuaded her to allow me to perform iridectomy. The operation had the effect of relieving her of pain for a week, when the trouble returned with renewed intensity, and she insisted on having the eye enucleated. I could not induce her to allow me to perform paracentesis. I performed enucleation.

The last case is that of a man 77 years of age, who has always enjoyed fair health. The vision of his right eye suddenly began to fail him, and when he came to me, the vision in that eye was $\frac{20}{200}$. In the other eye he had a hyperopic astigmatism of 3 D., which when corrected gave him V. $\frac{20}{20}$. The diagnosis of the trouble in the right eye was hæmorrhagic retinitis. I saw the patient from time to time for six weeks, the condition of the eye remaining the same. Not long after I lost sight of him for more than a month, when he sent for me to come to him at once. I found him in great agony with his eye, which objectively presented all the symptoms of an acute attack of inflammatory glaucoma. Pupil widely dilated, chemosis of the conjunctiva, and T. + 2. I employed eserine for twenty-four hours, but with no effect. Recalling the good effects of the paracentesis in Case 1, I determined to perform the same operation here. At my next visit, the morning after the operation, the patient remarked that it was the first night's rest he had had for a week.

Relief continued for five days, when he was again attacked with the violent ciliary neuralgia. Once more I resorted to paracentesis, and with the same happy effect. Twenty-four hours later the tension of the eye had noticeably gone down, and the patient was free from pain. I continued the use of eserine three times a day, and the eye, at the end of a week, had almost regained its normal external appearance. The result of this operation was to relieve him for ten days. On the eleventh day he sent for me, and I found him suffering again. The eye was intensely congested, and the anterior chamber was filled with blood, indicating a fresh hæmorrhage. This condition determined me to enucleate the eye, as I did not think any good would follow iridectomy. The eye was therefore taken out and put in Müller's fluid, and later sections were made.

Pathological Anatomy.—Cornea intact throughout. Iris was the seat of numerous small hæmorrhages, most abundant in the neighborhood of the corneal puncture. The canal of Schlemm was not to be seen. Hyaline degeneration of blood-vessel walls. The retina showed hæmorrhages throughout its internal part, extending into the external granular layer, and only exceptionally as far as the external nuclear layer. Inner half of retina presented here and there hyaline-looking drops separated by a reticulum, and no details of this part of the retina could be made out. Between the rods and cones there were to be seen formless drops, staining deeply with eserine. In the choroid there was to be observed an absence of nuclear staining, though this was not restricted to the choroid alone, it being the case also in the retina. The veins of the choroid were enormously distended with blood, and their walls apparently showed hyaline degeneration. In the papilla and elsewhere in the optic nerve hæmorrhages were present. The muscular coat of the central artery appeared to have undergone hyaline degeneration, as was the case with the arteries in general. Endarteritis was apparent in several of the smaller arteries.

As to the causes working to call forth the disease, in the three cases just reported we certainly have the comparative rigidity of the sclera incident upon the ages of the patients (certainly of two of them), and the refractive condition of the eyes, there being hyperopia and a certain amount of astigmatism in each case. The age of two of the patients, and the fact that they were subject to frequent attacks of sciatica and rheumatism, would lead one to look for general arterio-sclerosis. In the case of the woman who went blind prior to labor, age probably played a minor rôle, but a great and permanent disturbance of the circulatory apparatus must have been associated with the protracted labor, and the walls of the ocular blood-vessels must have undergone changes different from those which are at the bottom of other retinal diseases and which we see every day, and which we know do not lead to hæmorrhagic glaucoma. The family physician told me that he had tested the urine just before labor, and found a considerable quantity of albumen present. Another cause common to all three cases, and which is especially potent in the production of the disease, was the ciliary irritation, a condition tending to increase the fluid contents of the eye, according to experiments made on animals by von Hippel and Gründhagen.

With such numerous hæmorrhages and such widespread disease, the changes in the blood-vessel walls and in the substance of the retina itself must be of the highest grade, and consequently we would look for increased transudation and lessened resorption. It is impossible, of course, to predict anything as regards the continued soundness of the other eye in each case. Von Graefe reports the fact that of twenty-two cases, in ten the other eye had remained perfectly intact, although in this respect the disease can show the greatest variations. In four cases Graefe observed five months later the approach of hæmorrhages in the other eye, though glaucoma was absent. In one case, soon after the disease showed itself in the first eye, an intense retinal hyperæsthesia occurred in the other eye, characterized by seeing sparks and flashes of light. This disappeared. In six cases the second eye was finally attacked and blindness followed. Nearly a year has passed in the first of my cases, ten months in the second and seven months in the last case, and in each instance the other eye retains normal vision. As I said before, it was a matter of regret to me afterward that it was not possible in the second case to perform paracentesis. The patient would consent to no more attempts to

save the eyeball, and if I had the third case to treat over again, I should certainly try iridectomy first, and if necessary follow it up by paracentesis of the vitreous in the manner described above. There is no telling what the combined effect of these two operations might have brought about. They certainly realized every hope in the first case. And though permanent and positive relief was seen in only one case, one will gather from reading the history of the cases, that the whole tendency of the operations of paracentesis and iridectomy was to improve the condition of the patient, and hence I should conclude that iridectomy is not contraindicated in this form of glaucoma, but on the contrary, the operation does give temporary, and may give lasting, relief from suffering, and consequently it should always be tried first; and finally, that in paracentesis in the manner described in Case 1, it is possible still further to ameliorate the condition of the patient. As to prophylaxis in its bearing upon the other eye in each of these cases, I think this simply means sparing the eye all work, and absolute freedom on the part of the patient from mental and bodily fatigue.

And though the results of treatment in these three cases were far from brilliant, it is just in these kinds of extreme eye troubles, which have generally unsuccessful issues, that the histories, when carefully told, benefit us quite as much as brilliant results.

DISCUSSION.

DR. DE SCHWEINITZ reported cases of hæmorrhagic glaucoma with numerous small hæmorrhages, with cupping in one eye and no cupping in the other, due to arterial sclerosis. In the second case, only one eye being affected, there were widespread hæmorrhages obliterating the macula. There was albuminuria, a history of syphilis, and doubtless atheroma of the arteries.

DR. AYRES said iridectomy had been very unsatisfactory in hæmorrhagic glaucoma. He favors enucleation if no other means brought relief.

DR. J. H. THOMPSON does not favor enucleation, but prefers, instead, optico-ciliary neurotomy.

DR. RANDOLPH answered Dr. Thompson that he had seen many failures from optico-ciliary neurotomy in Baltimore, and did not approve it.

BOOK REVIEWS.

ATLAS OF CLINICAL MEDICINE. By BYROM BRAMWELL, M.D., etc., assistant physician to the Edinburgh Royal Infirmary, etc. Volume I, Part 1. Edinburgh: T. and A. Constable. 1891.

The first part of the first volume of this work has just been issued, and treats of Myxœdema; the clinical investigation of cases of Myxœdema; Sporadic Cretinism; the clinical investigation of sporadic cretinism; Myxœdema and Exophthalmic Goitre contrasted; Friedreich's Ataxia; the clinical investigation of Friedreich's Ataxia; notes of three additional cases of Friedreich's Ataxia.

The text is illustrated by five well executed plates, viz: 1, 2, 3, Myxœdema; 4, 5, Sporadic Cretinism.

With this part are also issued two additional plates, the first illustrating Lymphadenoma, and the second, Melancholia with Fear.

It is designed to issue the work in four parts each year, very fully illustrated. If that portion already issued is to be taken as a fair specimen of what is to follow, it may well be regarded as a work of more than ordinary merit. The first yearly volume is to contain thirty plates, 14½ by 10½ inches, colored, black and white, and photogravure, with detailed description of the plates and text. The Atlas will be issued to yearly subscribers only, and it is contemplated to continue the work through three years, and to include at least ninety illustrative plates.

ESSENTIALS OF SURGERY, together with a *Full Description of the Handkerchief and Roller Bandage*. Arranged in the form of questions and answers, prepared especially for students of medicine. By EDWARD MARTIN, A.M., M.D., Instructor in Operative Surgery, University of Pennsylvania, etc. Illustrated, fourth edition, revised and enlarged by an appendix, containing full directions and prescriptions for the preparation of the various materials used in antiseptic surgery, etc. Philadelphia: W. B. Saunders. 1891.

The first edition of this number of Saunders' Question-Compends appeared in 1888, and has now reached a fourth edition. Whatever view may be held as to the value of such aids to students it is evident that there is a demand for them, and this is no doubt increased by physicians who find such compends a convenient mode of reviewing the subject of which each treats, and which is supposed to be brought abreast of the times on that particular subject, so that he may get in a convenient way and in a concise form some of the most recent ideas on the subject, without sifting from the general literature of the subject.

The present number is one of the best of the series. The author may be said to have accomplished his avowed purpose of having furnished the "essential points as a framework upon which more detailed knowledge may be hung." His further claim "to be accurate, concise and modern" is well founded. The additions made in the present edition are noted on the title page.

SYLLABUS OF THE OBSTETRICAL LECTURES in the Medical Department of the University of Pennsylvania. By RICHARD C. NORRIS, A.M., M.D., Demonstrator of Obstetrics in the University of Pennsylvania, etc. Second Edition. Philadelphia: W. B. Saunders. 1891.

The first edition of this Syllabus was issued in 1889. This second edition has some additions, including chapters on infant feeding, pathology of the puerperium, obstetric operations and dystocia.

In addition to the table of contents, an index has been added, and it is interleaved for convenience in note taking. Being largely based on the course of lectures delivered in that University, it doubtless proves a great convenience to the students of that institution to whom it is dedicated, and no doubt will be so, in perhaps a less degree, to students in other institutions. The author may be congratulated on having been more than ordinarily successful in the task which he undertook in preparing the syllabus.

THE CONSTRUCTION OF SCHOOL BUILDINGS.

Read in the Section on State Medicine at the Forty-second Annual Meeting of the American Medical Association, held at Washington, D. C., May, 1891.

BY D. F. LINCOLN, M.D.,

OF GENEVA, N. Y.

CHAIRMAN OF THE COMMITTEE ON SCHOOL HYGIENE OF THE AMERICAN MEDICAL ASSOCIATION.

In dealing with this question, we are obliged to make allowance for difference in circumstances. We demand space, fresh air, light; and these needful things undeniably cost money. The poorer and less enlightened communities will grudge payment, even for such necessaries of life; but the number must be very small, of those who have not a disposition to improve, and a willingness to make some sacrifice. The burden does not always fall heaviest upon the poor districts; land costs next to nothing in the country, and the struggle for elbow-room between tall overshadowing buildings is unknown, while in rich cities it may happen that the millions appropriated for public schools are as inadequate as the hundreds granted by a country district.

The city school is greatly restricted in the space available for building; and in no city is this difficulty more pressing than in New York. Without assuming the right to condemn any one's omissions, we may still be permitted to offer suggestions which may meet with appreciation in certain quarters.

The suggestion, then, which is first offered, is to this effect, that it would be well if the space surrounding each school-house could be at the outset ample for the purpose of supplying light, and that regulations might be made to prevent encroachments upon the sky area. It could be ordered, for instance, that the width of such space be made equal to the height of buildings now standing, or likely to be erected, in contiguity; and that the height of such future adjoining edifices should be restricted. It may be difficult to anticipate the future. But surely we need not commit the blunder of allowing only a six or ten foot passage at the side of the school-house—of which it would be easy to point out examples.

To the recommendation of a liberal ground space may be added another of kindred character: that of moderate size and height in the edifice. The reasons for this are various. On the one hand, there are objections to the massing of great numbers of children; there is the difficulty of management to be considered, and other matters, the discussion of which may be omitted here. Apart from this, there are objections to the great, compact house, the central parts of which are remote from the freshness of the outer air and the beneficial effect of sunlight. Then there is the objection to many-storied buildings, on the ground of loss of time in passing scholars to and from the yards at recess, and on the further ground of occasional injury to the system in the case of girls in their teens, at the period of sexual development.

The safety of the inmates in case of *fire* should be insured by suitable arrangements of stairs, and by strict drill. I cannot approve of the ladders or twisting stairs of iron openwork clamped to the outside of the building, as a refuge for a crowd of panic stricken children. Safety requires that the ordinary staircases be planned so as to be incombustible, and that they should present no impediment or trap for the foot, such as spiral curves, narrow-cornered steps, steepness or dark passages. Stairways ought to be so placed that every room has access to more than one, in different directions.

Lighting.—The best opinions at present, in this country, seem to agree in preferring light which enters from the left side of the pupils, and in absolutely objecting to that which enters in front. Whether light should be admitted from the right hand or the rear cannot be categorically stated; in some circumstances (as in the case of small country school-houses), it seems a desirable addition to the left-hand light.

There are two mistakes, against which serious warning should be given. One is the placing of windows at a low point, for architectural or other æsthetic reasons. The best place for the light to enter the room is the highest point attainable. Windows should nearly touch the ceiling, and their upper part should be as free as possible from incumbrances which obstruct light. The other mistake referred to is the attempt to light very wide rooms of moderate height by side windows. The poverty of light in such cases is not to be estimated by the ordinary standards, or by one's impressions, but by observing the way in which the horizontal rays of light fall on a book placed *flat* on the desk as for study.

Verandas are fatal to good working light. The "Italian" awning is nearly as bad. In general, no form of curtain or other screen covering the upper part of a window is allowable except on the ground of strict necessity. If shades are required to exclude the sun, they must be removable when not needed.

The eye should be favored by avoiding the glaring effect of pure white walls; a slight neutral tint, or bluish or greenish, is preferable. The ceiling, however, may be as white as possible.

School-rooms.—Their dimensions are partly dependent on the requirements of ventilation. It may be added, that their length is limited by the distance at which the ordinary eye can read ordinary work on the blackboard, or not greatly over 30 feet. The width should not exceed the moderate dimensions which are compatible with good lighting—from 22 to 25 feet if light comes from one side.

The floors should everywhere be made of material which can be washed conveniently—a wood which will not splinter or wear ragged.

Seats and desks.—The American patterns in common use are at least comfortable—from one point of view. The chairs are very easy to sit back in when one is tired. In this they differ widely from the accepted patterns of the European schools, whose children are taught to sit up straight, and are furnished with short backed seats which support the hips sufficiently, but not the shoulders. These models are strange, to our eyes, and there is little chance of our rocking-chair-loving race adopting them at present. They possess obvious merit, however.

From the Germans we have learned that the front edge of the desk must reach or overhang the edge of the seat. This principle is commonly imitated among us. What we have not yet seen fit to adopt is the no less rational principle that the desk should not crowd the arms and elbows upward. The arms ought to hang so freely that the elbows, when writing is going on, are at the level of the desk. In no other way can we insure a correct—*i.e.* a straight and squared—position in writing.

In conclusion, let me say that a number of points have been left untouched in this paper, which might properly have been treated of, as related to the general subject of construction. This is due to the fact that a special assignment of the subject of drainage and sewage has been made, by which it is placed in the hands of another member of the committee; his work is expected at the next annual meeting.

PRE-COLUMBIAN SYPHILIS. — The growing prospect of a world's fair in 1892 or 1893 arouses an especial interest in things Columbian and pre-Columbian. Possibly among the latter may be classed syphilis. Dr. James Nevins Hyde discusses the question in the *American Journal of Medical Sciences*, and the discussion will, we trust, be continued. America has heretofore accepted too readily the dubious compliment of having bestowed upon civilization the *grosse vérole*. When one recalls what a sty of licentiousness and filth Europe was in the fifteen century, it seems much easier to suppose that syphilis was bred there than that it was imported. Dr. Hyde, however, takes up mainly the question whether the North American Indians of pre-Columbian times left any bones which show evident syphilitic lesions. A good many so called pre-historic bones showing signs of so called syphilis have been collected. But it has been shown that many of the remains in the Indian's mounds and caves are not pre-historic. Then, so far as the lesions are concerned, it appears to us from the evidence presented that none of them are plainly the results of syphilis. Dr. Hyde reports in detail the results of a microscopical study of two tibiæ from Colorado, made by Dr. T. M. Prudden. These showed the presence of a chronic rarefying and formative osteitis and chronic formative periostitis, changes which might be of syphilitic origin, but much more likely were not.

So far as the bones have yet told the story there was no pre-Columbian syphilis.

Its presence will have to be established by further bony studies, as well as by historical, and perhaps philological investigations.—*N. Y. Med. Record.*

MEDICAL PRACTICE IN CONNECTICUT.—The *Monthly Bulletin of the Connecticut Board of Health* contains the following reply, sent to a doctor inquiring of a State official if he would be allowed to practice in Connecticut by registering his name and the college from which he graduated: "SIR:—Anybody can practice medicine in Connecticut. You do not need to register; you do not need a medical diploma; you do not need to know the difference between opium and peppermint—you do not, indeed, need to know anything. You can simply come and live here, and begin to practice. The laws of Connecticut will sustain you in collecting your fees for professional services, if you render any which you choose to call such. But if you undertake to carry me or my trunk to the depot for pay, you must get a license. If you peddle matches or peanuts, you must get a license. If you collect the swill from your neighbors, to feed your pigs, you must get a license. If you want to empty your cesspool, you must get a license. But you can practice medicine in Connecticut *without a license.*"—*Boston Med. and Surg. Journal.*

LEPROSY IN JAMAICA.—Dr. Donovan, in his annual report to the Governor, on the Lepers' Home, Jamaica, estimates the leper population of the island at 450, or one leper to 1,380 of the population. Pending general legislation on the question of isolation, he recommends a prohibitive enactment against lepers keeping provision stores or being employed therein, or in the preparation of food; that no leper be allowed to engage in any of the following vocations, namely: baker, butcher, fisherman, tailor, school-teacher, etc.

FOR PERSISTENT DANDRUFF.—Dr. Stephen recommends that we should use a mixture of 3 scruples each of resorcin, olive oil and sulphuric ether, and 6½ ozs. of alcohol. To be well shaken and applied to the scalp by a bristle brush about twice as large as the ordinary mucilage brush, by insinuating it with the locks of hair; the head to be well washed with soap and warm water twice a week.

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SATURDAY, SEPTEMBER 12, 1891.

TREATMENT OF CROUPOUS PNEUMONIA.

A review made a few years ago of the cases of pneumonia treated at the Massachusetts General Hospital showed that there was little or no difference in the mortality under various methods of treatment; that whether heroic onslaughts were made on the disease by the so-called antiphlogistic plan, blood-letting, and active purgation, or whether a purely expectant plan of treatment was pursued, or supporting efforts by stimulation were employed, the percentage of mortality was not materially different. Nevertheless, but few practitioners are ready to admit that their efforts in this disease are without avail, although many will be ready to admit that the results of treatment are sufficiently unsatisfactory to warrant careful attention being given to any plan which offers a rational procedure, no matter how widely it may differ from the methods now generally in vogue.

All authorities are agreed that the danger point in pneumonia is the heart, but all are certainly not agreed as to the mechanism of this danger.

We are all too prone to regard the *left heart* as *the heart*, and to forget that there are two hearts, more or less independent of each other. Dr. S. HENRY DESSAU, in the last number of the *Archives of Pediatrics*, reviews the subject quite fully, referring to the work of Dr. A. H. SMITH, of New York, in a paper read before the Berlin Medical Congress in 1890. Dr. SMITH called attention to the interference with the circulation produced by the engorgement of the lung, and showed that the *right heart*, and not the heart as a whole, was the main source of exhaustion, and that the character of the second pulmonary sound was a better guide to the conditions present than the pulse. The pulmonary circulation is obstructed by the permanent dilatation of the vessels in the engorged lung, and overcrowding of the right heart necessarily occurs. In the systemic circulation, on the other hand, the arterioles are contracted, forcing the left heart to more rapid and more powerful contractions, which result in overfilling the veins, and forcing upon the already overburdened right heart a surplus of blood to be handled. The overcrowding of the right heart from the venous side tends to produce dilatation of the right ventricle before a compensatory hypertrophy can be established. It is not surprising, therefore, that in individuals in whom the nutrition of the heart muscle has been seriously impaired, as in alcoholic or nephritic cases, the mortality from pneumonia should be unusually high.

With this view of the pathology, the treatment, so far as the circulation is concerned, consists in relieving the right heart by increasing the capacity of the systemic arterial system, and by diminishing the pulse rate.

As a means of dilating the cutaneous blood vessels and producing diaphoresis, DESSAU suggests spirits of nitrous ether, DOVER'S powder, or spirits of mindererus. The warm bath at 95° F., or sponging of the entire body with water at 116° F. is also recommended. The warm bath and hot sponging are given for the purpose of dilating the cutaneous vessels and inducing diaphoresis, and should be so conducted as to accomplish these ends. Conjointly with these means, the use of friction to the skin may be advantageously employed.

As a further means of relieving the right heart, efforts should be made to divert the venous blood into the liver, a reservoir capable of holding a great quantity of this fluid. It is also suggested that the increase in blood to the liver will stimulate its functions, among which is to be noted the destruction of poisonous principles in the blood.

For the purpose of stimulating the liver, he suggests the use of small doses of calomel.

Aconite is mentioned as a remedy which, carefully administered, will reduce the heart's action without depression, and furthermore assist in dilating the cutaneous vessels and promoting perspiration.

With regard to digitalis, it is urged that it can only do harm, by contracting the arterioles of the systemic circulation and increasing the force of the heart's action.

The use of aconite and veratrum in pneumonia has long found favor in the hands of many practitioners, who were unable to reconcile their good results with the objections of the theoretical men who insisted that aconite produced slow collapse.

The favorable action of calomel in pneumonia has been often noted by many practitioners, particularly those of the older school, but it seems reasonable to suppose that, with such indications for its use as are given by DR. DESSAU, better results may be expected than could be obtained by a merely empirical exhibition of the remedy.

While seeking measures to relieve the heart of the strains thrown upon it, it should not be forgotten that there are other features to be considered in pneumonia. The disease is accompanied with various nervous manifestations, evidences of the poison at work, which cannot be accounted for simply by the elevation of temperature. These poisons must be directly counteracted or eliminated. Fortunately, the means employed to relieve the right heart also assist in elimination, and in this way are probably doubly useful. But the necessity of using the most appropriate channel of elimination in the particular case must not be overlooked. In some instances, particularly in those in which typhoid symptoms, coma, and low muttering delirium intervene, with low temperature, the modern antipyretics, judiciously used, appear to exercise a truly antidotal specific effect.

How far DR. DESSAU'S views may be found to stand the critical examination of the future, they are certainly at present worthy of careful consideration.

THE UNIVERSITY OF VERMONT.—Dr. Condict W. Cutler, of New York, has been appointed Professor of Skin and Venereal Diseases, to succeed Dr. R. W. Taylor, who has resigned.

IMMUNITY AGAINST CROUPOUS PNEUMONIA.

While upon the subject of the treatment of pneumonia, the experiments of Prof. EMMERICH of Munich, relating to the production of an artificial immunity against this disease and to curing the same, should be noticed. EMMERICH has just reported his experiments before the late Congress of Hygiene and Demography in London.

From previous experiments EMMERICH has been led to believe that immunity against infectious disease is produced by a toxine inimical to bacteria, but innocuous toward the cells of the animal body. In an immune animal, at least soon after immunity has been produced, this substance should be found in its blood and other tissue fluids.

By subjecting a rabbit to an intravenous injection of a very dilute but completely virulent culture of the *diplococcus pneumoniæ Fränkeli* it is rendered immune. Rabbits so prepared were killed, skinned, divided and rubbed up into a fine paste, which was pressed through the meshes of a clean sterilized cloth. The bloody juice was kept for twelve hours at a temperature of 10 C. (33.8° F.) then sterilized by passing through a Pasteur filter. Twenty-six rabbits, one of which had been subjected to an injection of the immunizing juice, were subjected in an inhalation apparatus to the action of a spray of bouillon culture of diplococci. All died speedily except the one animal protected by the immunizing juice.

In a second series of experiments seven mice were injected with a virulent culture of the *diplococcus pneumoniæ*, in quantities varying from 3 c.c. to 5 c.c. Six of them were then injected with the immunizing or curative juice as it may now be called. In 44 hours the unprotected mouse was dead, the autopsy showing diplococci in the blood and internal organs in great quantities, while the other six mice were all well. As these last experiments were made during the last three days of July, we must wait further for fuller returns. [1]

In a further experiment with three mice, the first two were injected with .5 c.c. and the third with .3 c.c. of a virulent culture. Five hours later the first two mice received 2 c.c. of the curative juice, but not of a fresh preparation.

[1] Maximillian Herzog, Cincinnati Lancet-Clinic, Vol. xxvii. N. S. 301.

The following day all of the mice were sick, the third being worse than the first two. The first was given an injection of 1 c.c. of perfectly fresh curative juice, whereupon it recovered rapidly. The second and third both died.

THE CONGRESS OF AMERICAN PHYSICIANS AND SURGEONS.

Washington, September 22, 23, 24. The apparent indications are that this will be a great success, both in attendance and in the character of the papers, with accompanying discussions. The coming together of leading investigators and specialty practitioners in the various departments of our art will be fraught with great good especially to those who attend the Congress, as well as to the profession at large.

The men who have won renown by reason of their attainments, are usually the ones who are most wide awake and ready to pick up and utilize the expressed thoughts of their fellows, while very often their own idols are shattered beyond possible recognition.

Specialists in the great Eastern, Central, Western and Southern cities will do well to place themselves in more close affiliation with each other. Art and science are cosmopolitan. The assemblage of men engaged in similar lines of labor and thought, from every geographical direction, favors the dissemination of knowledge, besides placing themselves one with another in desirable business channels.

The social features of these gatherings of the intellectual laborers in our particular vineyard are hardly, if at all, second to the ostensible purpose of the occasion.

The men who can go, ought to do so as a matter of duty owed to themselves, as well as the more unselfish one they owe to others. It is quite doubtful if any professional workingman's annual income appreciably suffers through his attendance at medical society meetings.

The world has come to not only regard and recognize, but to know that organized labor, is more skillful, more effectual and more complete in its performance of a given work than that which is done under conditions of segregation.

Joined and welded together for a common purpose, a great profession like that of medicine is capable of doing an unlimited amount of good both for its individual members and for the people at large. No man can alone accomplish and work out of his own ideals, he must have the aid of his fellows. This may be had at a society meeting.

THE "CATHOLEPISTEMIAD OR UNIVERSITY MICHIGANIA."

Have we a "Catholepistemiad" in our midst? A curious bit of the educational history of the territory of Michigan — inclusive of a medical embryo—has been brought to light in Dr. F. W. BLACKMAR'S essay on "State Aid to Higher Education in the United States." Dr. BLACKMAR is a member of the faculty of the University of Kansas, and his essay is one of the circulars of the Bureau of Education. The following paragraph shows that medicine was one of the projected departments of an institution of learning, based on a broad foundation, as far back as 1817, when the population of the territory did not number over seven thousand souls. The grant of a township of land for a seminary of learning was made by Congress as early as 1804, but the enabling act for the establishment of a university did not pass the territorial legislature until 1817. In that year, "the territorial government committed the interests of higher education to the care of the governor and the judges, and it is supposed that through the exertions of Hon. A. B. WOODWARD, then presiding judge of the supreme court of the Territory of Michigan, that the act establishing a university was framed. A portion of this most curious document of the early history of Michigan will be given. It is entitled An act to establish the Catholepistemiad or University Michigania.

Be it enacted by the Governor and Judges of the Territory of Michigan, That there shall be in the said Territory a catholepistemiad or university denominated the Catholepistemiad or University Michigania.

The Catholepistemiad or University of Michigania shall be composed of thirteen didaxum or professorships; first, a didaxia or professorship catholepistemia, or universal science, the dictator or professor of which shall be president of the institution; second, a didaxia or professorship of anthropoglassica, or literature embracing all of the epistemum or sciences relative to language; third, a didaxia or professorship of mathematica

or mathematics; fourth, a didaxia or professorship of physiognostica or natural history, etc. The act thus continues through the whole range of the thirteen didaxum. The remaining nine are as follows: Natural philosophy, astronomy, chemistry, medical sciences, economical sciences, ethical sciences, military sciences, historical sciences, and intellectual. The university was to be under the control of the professors and president, who were to be appointed by the governor, while the institution was to be the center and controlling power of the educational system of the State. It was to be supported by taxation by an increase of the amount of taxes already levied by 15 per cent. Also power was given to raise money for the support of the university by means of lotteries.

This remarkable document was not without its influence in shaping the public school policy of Michigan, but it was many years before the State approximated its learned provisions. Impracticable as this educational plan appears for a handful of people in the woods of Michigan, it served as a foundation upon which to build. The officers and president were duly appointed, and the work of the new university began at once."

Although the teaching of medicine was thus early taken into consideration by the founders of a great State, thirty years elapsed before the first medical faculty of Michigan took on its outward form and feature.

ONE THOUSAND CASES OF PNEUMONIA TREATED IN HOSPITAL.

DR. FENWICK, of the London Hospital, has given to the *Lancet* an analysis of 1,000 cases of pneumonia seen in that institution during the last ten years. Cases admitted shortly before death took place or twenty-four hours before a critical turn in the disease, are omitted from this report. In the sthenic cases, which numbered 500, the treatment was generally along the three general courses described as follows:

First. Treatment by means of hot applications to the chest, in conjunction with remedies having tonic and expectorant properties. The mortality in this class of cases exceeded 20 per cent. Second. Cases in which the only treatment was by quinine in large doses. The mortality here exceeded 20 per cent. Third. Cases where the treatment was by various antipyretic measures. In twenty-six of these, cold applications to the chest were employed, with a mortality of 15 per cent. The cold pack was tried in an equal number of cases, with about the same mortality. Cold sponging, used in fifty-six cases, had a mortality of 13 per cent. The "ice cradle" was used in forty-three cases, mortality only 7 per cent. By all the various cold applications 108 cases were treated, with 10 per cent. of failure. By all other grouped phases of treatment, the losses were double those by the cold method. Stimulants were given in these latter cases whenever indicated. Cold appears to be the best of the antipyretics for the class of patients with which DR. FENWICK has to deal, chiefly for the reason that it has less of depressant action upon the heart than antipyrin, quinine, etc. In the earlier stages of the disease, the true treatment involves a reduction of the temperature without cardiac depression. In the later stages, the pulse is the great guide for treatment in the matter of strengthening the recuperative forces by means of stimulants. In many cases, camphor, digitalis and alcohol will not be needed, but in impending cardiac failure these agents become vastly important. The period of crisis, also, is attended with especial dangers referable to cardiac incapacity, and it is necessary to be watchful and guard the patient, at this stage, by means of alcoholic and other suitable forms of stimulation.

A NEW DISEASE.

A disease popularly designated in the south of France under the name of "maladie des cannes de Provence," or in other words, the cane-disease, has recently been described by DR. VINCENTE GOMEZ in the *Revista de medicina y cirurgia prácticas*. He reports three cases of occupational disease, apparently due to the reeds. His first case was that of a man of 50 years, who had worked with the reeds for ten years. The canes lately used had been collected during the previous winter, and were covered with a fine ash-like dust, which was diffused through the air as the canes were moved. On the day following the first active diffusion of this dust, the man was taken with an intense headache, loss of appetite, insomnia; perspiration became profuse and urine scanty. A painful tumefaction of the nasal and

buccal mucous membrane followed, with epistaxis. There was also some irritation of the external genitals. On the sixth day, there was some low febrile action, a slight amount of albuminuria, anorexia, with dry tongue and fetid breath, dull red, scaly eruption on the cheeks; prepuce inflamed and very painful, with complete phymosis. In the two other cases the attack was less marked, for the workmen, seeing the dust arising in a cloud when the canes were agitated, and knowing something of its irritating properties, quit their work. This dust is most abundant upon those canes that are cut on marshy ground after exposure to both heat and humidity. The gravity of the morbid influence of this dust seems to be in proportion to the amount of it that is present and diffused through the atmosphere wherein the cane-workers are employed, and as remarked above, those who have had experience with this *maladie des cannes* find it expedient to escape from the dust when a large package of their working material is opened or agitated. DR. GOMEZ attributes the affection to products of fermentation (zymosis), which develop upon the reeds. A microscopical examination has not yet been reported.

REFRIGERANT LANOLINE UNGUENTS.

Professor UNNA gives in the *Therapeutische Monatshafte* the results of numerous experiments with lanoline and ointments made therefrom. Among the earlier researches of himself and others it was thought advantageous to mix water with lanoline in order to get a good base for a variety of cooling unguents, this being done for the reason that very considerable quantities of water—or aqueous solutions—could be incorporated with lanoline, and it came to be thought that these mixtures would have refrigerant properties in consequence of the continuous evaporation of their contained water, by the heat of the surface of the body. But the results did not at all confirm the hypothesis, for even if such lanoline and water ointments did appear at first to be cooling, this sensation disappeared quite rapidly and was followed by a sensation of heat. UNNA then discovered that an admixture of lanoline with fats will take up large quantities of aqueous solutions, and yield combinations that are continuously and in a high degree cooling. Hence, according to UNNA'S explanation, it is to be assumed that the anhydrous lanoline holds the water too closely, so that evaporation cannot occur with sufficient rapidity, but by mixing fat or oil with it the compound is rendered less tenacious of water, and therefore the desired degree of evaporation can quite readily take place. UNNA reckons that the best proportion of lanoline: of glycerine fats: and of aqueous solutions is as 10.0: 20.0: 30.0, for the compounding of a cooling ointment; while if he has in view a cooling cream (cremor) the proportion should be 10.0. 20.0: 60.0. A simple refrigerant ointment, to be used as a cold cream, may be made as follows:

Anhydrous lanoline	10.0
Benzoated lard	20.0
Rose water	30.0

The following is a lanoline imitation of GOULARD'S cerate:

Anhydrous lanoline	10.0
Benzoated lard	20.0
Solution of subacetate of lead	30.0

A lanoline salve for burns is the following:

Anhydrous lanoline	10.0
Benzoated lard	20.0
Lime water	30.0.

A refrigerant zinc ointment:

Anhydrous lanoline.	10.0
Benzoated zinc ointment	20.0
Rose water	30.0.

UNNA advised that, in this form of cooling unguents, only the anhydrous lanoline (lanolinum anhydricum) should be prescribed. These formulæ are designed for extemporaneous use, and are unsuitable for storing.

POISONING BY SULPHONAL.

A writer in the *Medical Press and Circular* gives a caution regarding the very indiscriminate use to which sulphonal is frequently put even by the laity. This drug was introduced about three years ago as a perfectly safe soporific, and corroborative testimony of this hopeful candidate have been abundant. Latterly there have been a few contrary reports about the safety and efficacy of the remedy, and the size of the maximum or poisonous dose could not be unanimously agreed upon. We have not a few cases on record where about three tablespoonfuls have been taken to produce sleep; in one of these cases the sleeper slept the greater part of five days and a half with-

out permanent injury to his nervous system. Another person took a dose about one-third smaller, but never reawakened. A more unusual and extreme case has recently been reported by DR. ERNEST NEISSER. A chemist's assistant, aged fifteen years, took with suicidal intent the contents of two boxes containing fifty grammes each, equivalent in all to three ounces, and over, of the fine pulverized sulphonal. The greater part of the drug was taken mixed with water, but some part of it was swallowed dry, and all of it was ingested within forty-five minutes. Six hours later he was found lying in a comatose sleep and was sent to a hospital, where he lay five days and nights in an unconscious condition. On the sixth day the awakening process took place gradually and on the ninth day he was discharged cured; he was apparently perfectly recovered from all the after-effects of the enormous doses he had taken. In the great disparity of these recorded cases, we read the lesson either of a want of uniformity in the manufacture of the drug, or of an undiscovered "personal equation" in those cases where the comparatively small dosage resulted fatally. At all events, a certain amount of caution should be observed when ordering the drug for patients who have not heretofore been brought under its influence.

SILVER CHLORIDE IN WHOOPING-COUGH.—Lœffler advises the use of freshly prepared chloride of silver in the prevention and treatment of whooping-cough. As given in the Boston *Medical and Surgical Journal*, his preferred combination is the following: Chloride of silver (freshly prepared), 1½ grains; water, 2 pints; hyposulphite of sodium, a saturated solution. Mix. Use by an atomizer, the spray being directed into the pharynx. Repeat the application every two or three hours.

AT THIS season of the year the conditions of travel are as nearly perfect as possible, and for those going from south and west points, a railway ride over the mountains, by way of the Chesapeake and Ohio route, is a luxury that is charming beyond description, while the car service is as perfect as one may expect to find on wheels. The delegates who attended the late meeting of the American Medical Association and went over this route, were profuse in their expressions of pleasure and appreciation. Wisely, the Arlington Hotel has been made the professional headquarters of the Congress of Physicians and Surgeons. The accommodations of this hostelry are ample, and in every respect equal to the demands of the most fastidious. Those who go and want to be in the swim should engage rooms at the Arlington.

DOMESTIC CORRESPONDENCE.

LETTER FROM NEW YORK.

(FROM OUR OWN CORRESPONDENT.)

For a time during the month of August just past, the temperature was higher than for many years previously in this city; yet, strange to say, the fatal results due directly to the heat were proportionally very small. The total number of deaths directly attributable to the heat was 48, and of these, 37 occurred during the three hottest days, August 10, 11 and 12; when the highest point registered by the thermometer was respectively 98, 95 and 92 degrees in the shade, and 135, 134, and 133 in the sun. The statistics of the Health Department fail to show any such register since 1866, when the complete records begin. These records show that the heated term in July, 1872, was the most fatal that the city has experienced. During this famous hot week which ended on the sixth of July, the mortality rose from 807 (that of the previous week) to 1,591. The following extract in regard to this week is taken from the books of the Health Department:

"Although an excessive mortality for the summer, as compared with the rest of the year, is periodical in New York, the unwonted period of its occurrence in 1872 was peculiarly striking. The maximum mortality of the year had never previously been recorded so early in the season. It will suffice to go back as far as 1855 in corroboration of this fact. From that time during ten successive years, the greatest weekly number of deaths was never attained until the third week in July; in one year (1857) it was delayed until September, and in six out of the ten until August."

The highest temperature reached on June 30, July 1, 2, 3 and 4, in 1872, was 95, 95, 96, 94, and 95, respectively, in the shade, and 124, 125, 128, 120 and 123 in the sun; while the mortality from sunstrokes on these days was respectively 7, 34, 68, 43 and 44. These figures show that, in spite of the fact that the temperature was markedly higher in the hot spell in August of this year, the mortality of that in July, 1872, was markedly greater than has been the case in the latter. A possible explanation of that fact may be found in the circumstance that, whereas in 1872, the extreme heat came suddenly at the beginning of the season, thus finding the population totally unprepared for the severe strain, this year the trying time very late in the season, after several weeks of warm weather, which gave the people a chance to be prepared for it.

Since 1872, there has been no year in which the number of deaths from sunstroke has approached its large total of 320, although six years before that, in the summer of 1866, the number nearly equalled that, viz.: 310. Only three times within the past seventy years has the mercury in this city reached or exceeded the 100 mark. In July, 1821, the temperature reached 100 degrees in the shade, and in July, 1825, it reached its highest known record of 107. There are, however, no statistics preserved of the mortality of either of those months. The third time was in September, 1881, when the mercury registered 101.

It seemed appropriate that during the hot weather of August, the first permanent public baths ever established in New York should be opened to the public. The free baths along the two river fronts of the city are, of course, an inestimable boon to the poor; but in them the water is not always as clean as could be desired, and, from the nature of things, they can be enjoyed only during a comparatively limited portion of the year. The "People's Baths," which have now been inaugurated, not by the city, but by the Association for Improving the Condition of the Poor, it is proposed to keep open for fifteen hours a day during every day of the year. The system adopted is that of the rain or shower bath now in successful use in Vienna and other European cities, and it was principally due to the advice of Dr. Simon Baruch, who is such a high authority on balneology and hydro-therapeusis, that this plan was followed in the construction of the baths. Early last spring he read a paper before the Section of Hygiene of the New York Academy of Medicine, in which he urged the superior cleanliness and economy of the rain bath system for general use, and made a forcible plea for the establishment of permanent public baths of this character in New York.

The matter was at once taken up by the Association for Improving the Condition of the Poor, a society which for many years has been doing a vast amount of good by systematic and intelligent charitable work. To quote the language of the President, in his address on the occasion of the formal opening of the baths, "this Association is not merely a relief society, but it has ever in view the amelioration of the conditions, often unhealthy and uncomfortable, under which so large a proportion of the inhabitants of the city are compelled to live. It strives to better these conditions through its sanitary department, which is in constant communication with the Board of Health, receiving from the latter the most effective advice and coöperation. It also carries on a great work in sending 1,500 to 2,000 people, chiefly mothers and children, weekly to its establishment on Coney Island, where they have fresh air, abundant food, sea bathing, and much innocent enjoyment."

Some time ago the New York City Mission had received a donation amounting to over $6,000, for the purpose of establishing free baths, but, as its managers did not care to undertake this work, they very generously turned over this fund to the Association, and at the same time offered a suitable site in the midst of the East Side tenement house district, for the construction of the baths. The building, exclusive of the land, has cost about $25,000, and its facilities are capable of accommodating nearly 1,000 bathers daily. A charge of 5 cents is ordinarily made for each bath, including the use of a good towel and the present of a small cake of soap, but provisions have also been made by which the very poorest can obtain their baths free. As the male and female departments are entirely distinct throughout, women and girls can bathe at all times, and not merely on certain days or at special hours.

Dr. Abram Du Bois, one of the most honored members of the profession in New York, died on the 29th of August, in the 82d year of his age. He was one of the most generous benefactors that the Academy of Medicine ever had, and the large and handsome hall in the rear of the old building on 31st street, with a meeting room below and accommodations for the library above, was entirely his gift. He was one of the founders of both the New York State and County Medical Associations, and was deeply grieved at the course of the Academy of Medicine in repudiating the National Code of Ethics. At one time he signified his willingness to give the handsome sum of $60,000 for the construction of a permanent building for the State Association in this city, provided a certain amount was subscribed by other Fellows of the Association; but the desired fund was never raised.

P. B. P.

NECROLOGY.

Dr. Abram DuBois, of New York City, died August 29, aged eighty-one years. From the time of his graduation, in 1835, at the College of Physicians and Surgeons, to his retirement from active practice, about 1880, Dr. Du Bois was noted for his devotion and generosity toward every worthy professional undertaking. The Academy of Medicine, in one year, received from him $8,000 for library purposes. He was a pioneer in specialism in New York, giving his chief attention to ophthalmology from the outset of his professional life. He was for many years the senior consulting surgeon to the Eye and Ear Infirmary, and a liberal benefactor thereto.

The Point of Selection in Paracentesis of the Abdomen.—In an editorial in the *International Journal of Surgery*, May, 1891, the question of paracentesis abdominis is discussed, and a case of Frzebicky's (*Archiv. fur klinische Chirurgie*) quoted, in which profuse hæmorrhage occurred from a puncture made at Munro's point, which is midway between the umbilicus and the anterior superior spine of the ilium. If the puncture is made at this point a considerable number are apt to be followed by hæmorrhage. Directly in the linea alba is the best place, and if this is not possible it should be made in the outer half of a line drawn from the umbilicus to the anterior superior spine of the ilium.

MISCELLANY.

THE INTER-CONTINENTAL AMERICAN MEDICAL CONGRESS.—Dr. J. C. LeHardy, member of the Auxiliary Committee of the Inter-Continental American Medical Congress for Savannah, Ga., writes to Dr. C. A. L. Reed, Chairman of the National Committee, as follows: If money can be secured we ought to make the occasion an epoch in the history of medicine. It seems to me that the distinct feature of this Congress should be to have as complete a display as possible of the medicinal plants and medicinal preparations, of the surgical instruments and appliances, electric and other machinery, of all scientific instruments and devices *used at this time* in the different parts of North and South America and islands surrounding, or, if possible, in the whole world, by the savages and semi-civilized, by the negro slaves and those that have been freed, by backwoods quacks and doctors and by those who have attained the highest grade in civilization and knowledge. Competent persons should be employed as soon as possible to collect these among the Indians and from the Negroes on the Atlantic Coast and in Central and South America.

Dr. Reed will lay the suggestions before the National Committee which meets in St. Louis, October 14th.

THE AMERICAN ASSOCIATION OF OBSTETRICIANS AND GYNECOLOGISTS.—Programme of the Fourth Annual Meeting, to be held in the hall of the Academy of Medicine, 17 West Forty-third street, in the City of New York, Thursday, Friday and Saturday, September 17, 18 and 19, 1891. All persons interested are most cordially invited.

First Day, Thursday, September 17, 1891.

Business meeting at 9:30 o'clock A.M., for Fellows only.

Morning session, 10 o'clock.

1. Address of Welcome and Response, Drs. Roosa and Rohé.
2. Post Partum Hæmorrhage; Its Etiology and Treatment; Dr. Aug. P. Clarke, Cambridge.
3. Removal of the Kidney for Disease, with Cases, Dr. William J. Asdale, Pittsburgh.
4. Another Method of Palpation of the Kidney, Dr. Robert T. Morris, New York.
5. Intra-Uterine Irrigation after Labor, Dr. Lewis S. McMurtry, Louisville.

Afternoon Session, 3 o'clock.

6. Is a Child Viable at Six and a Half Months? Dr. Llewellyn Eliot, Washington.
7. Some of the Dangers Incident to Delay in Operating for Uterine Myomata, Dr. Isaac S. Stone, Washington.
8. How Should We Proceed when Abdominal Tumors are Complicated by Pregnancy? Dr. James F. W. Ross, Toronto.
9. Thoughts Pertaining to Maternal Impressions During Gestation, Dr. William S. Stewart, Philadelphia.

Second Day, Morning Session, 10 o'clock.

10. Removal of the Uterine Appendages, with Results, Dr. Milo B. Ward, Topeka.
11. A few Abdominal Sections Selected from my own Work, Dr. William H. Myers, Fort Wayne.
12. The Prevention of Secondary Peritoneal Adhesions by an Aristol Film, Dr. Robert T. Morris, New York.
13. The President's Annual Address (12 o'clock M.), Dr. Adam H. Wright, Toronto.

Afternoon Session, 3 o'clock.

14. Asepsis in Abdominal and Pelvic Surgery, Dr. William H. Wathen, Louisville.
15. A Case of Cholecystotomy and Cholelithotrity; Death from La Grippe on the 21st day, Dr. William Wotkyns Seymour, Troy.
16. Report of Cases of Cholecystotomy, with Special Reference to the Treatment of Calculus Lodging in the Common Duct, Dr. A. Vander Veer, Albany.
17. Femoral and Ventral Hernia in the Female, Dr. Henry O. Marcy, Boston.

Business Meeting at 7:30 o'clock for Fellows only.

Third Day, Morning Session, 10 o'clock.

18. Some Moot Points in Ectopic Gestation, Dr. X. O. Werder, Pittsburgh.
19. Ectopic Pregnancy; When Shall we Operate? Dr. Rufus B. Hall, Cincinnati.
20. Trendelenburg's Posture in Gynecology; With Demonstrations, Dr. Florian Krug, New York.
21. Treatment of Minor Lacerations of the Perinæum, Dr. George R. Shepherd, Hartford.
22. Peritonitis Dr. Mordecai Price, Philadelphia.

Afternoon Session, 3 o'clock.

23. Peritonitis, Dr. Edwin Ricketts, Cincinnati.
24. Manual Rectification of Certain Malpositions of the Head in Labor, Dr. William H. Wenning, Cincinnati.
25. A Plea for Early Hysterectomy and Puerperal Hysterectomy, Dr. Joseph Price, Philadelphia.
26. Observations on the Surgical Management of Pelvic Abscess, Dr. Charles A. L. Reed, Cincinnati.
27. The Essential Question of Drainage in Pelvic Surgery, Dr. Lewis S. McMurtry, Louisville.

The Windsor Hotel, Fifth Avenue and Forty-seventh Street, will reduce its regular rates to Fellows and guests of the Association.

AUSTIN DISTRICT MEDICAL SOCIETY.—The sixteenth quarterly meeting of the Austin District Medical Society will meet at Austin, Tex., Thursday, September 24, 1891.

Officers: J. W. McLaughlin, M.D., Austin, President. W. A. Ellison, M.D., Manchaca, First Vice-President. J. W. Hamilton, M.D., Lampasas, Second Vice-President. T. J. Bennett, M.D., Austin, Secretary and Treasurer.

Censors: T. O. Maxwell, M.D., Fiskville, Chairman; S. E. Hudson, M.D., Round Rock; F. R. Martin, M.D., Kyle; A. N. Denton, M.D., Austin; J. A. Davis, M.D., Austin; H. H. Thorpe, M.D., Liberty Hill.

The Society will meet in Medical Hall, and will be called to order promptly at 9:30 A.M.

Programme, Morning Session:

1. Reading of Minutes.
2. Application for Membership.
3. "Syphilis," by Dr. C. O. Weller; discussion opened by Drs. Matt. M. Smith and H. H. Thorpe.
4. "The Advantages of the Supra-Pubic Operation in Cystotomy," by Dr. W. M. Cunningham; discussion opened by Drs. W. J. Matthews and J. W. Hamilton.

Afternoon Session, 2:30 o'clock.

5. "Acne," by Dr. F. E. Daniel; discussion opened by Drs. Fannie Leake and L. H. Hardy.
6. "Biliousness," by Dr. W. E. Shelton; discussion opened by Drs. J. A. Davis and C. A. Danforth.
7. Voluntary Papers.
8. Verbal Reports of Cases.
9. Unfinished Business.
10. New Business.

J. W. MCLAUGHLIN, President.
T. J. BENNETT, Secretary.

Official List of Changes in the Stations and Duties of Officers Serving in the Medical Department, U. S. Army, from August 29, 1891, to September 4, 1891.

Capt. Adrian S. Polhemus, Asst. Surgeon, granted leave of absence for one month, to take effect on or about September 3, 1891.

Surgeon J. V. D. Middleton, U. S. A., is granted leave of absence for fifteen days.

Major James P. Kimball, Surgeon U. S. A., is granted leave of absence for twenty-five days.